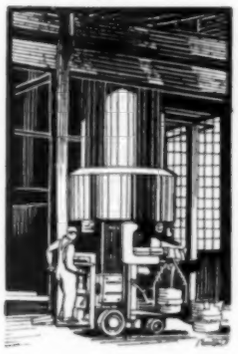


THE FOUNDRY

for April

Recognized ABROAD

WARM commendation is expressed by the *Foundry Trade Journal*, official organ of the Institute of British Foundrymen for the symposium on cast iron recently published by the American Foundrymen's association. This publication which contains papers and discussions prepared by a committee and presented at the 1933 meeting of the American Society for Testing Materials, represents a comprehensive study of the properties of modern gray iron. The British commentator pays a deserved compliment to the character of the technical information contained, but is even more impressed by the value of this work to designers and engineers in acquainting them with the potentialities of gray iron in engineering construction. In urging some similar undertaking in Britain, he says, "Whilst competition from welding throughout Europe is decreasing, a proper intelligently compiled book outlining the properties of cast iron would help to accelerate this pronounced tendency and to reinforce the general confidence which exists as to the reliability of cast iron." His point is well taken. To realize fully the benefits of the symposium, which represents the best abilities of some unusually competent, but anonymous, experts, the widest possible distribution and use should be encouraged. Every gray iron foundryman should see that a copy of the symposium is in the hands of every present and potential user of his products.

Consumer STANDARDS

WHAT a thrill of merit must tickle the spines of many who have left the cloistered seclusion of their college halls to serve as champions of the noble cause of consumer interests, under NRA. They plan a crusade on behalf of the oppressed, in this case the great class of American common people who always buy and consume, and never produce or sell. This class has been the bleeding victim of predatory manufacturers, flanked by the deliberately malicious forces of advertising and merchandizing, according to the quoted statements of one spokesmen of this group. But rescue is at hand. It is proposed that standards of quality and size backed by government brand or label shall be established and enforced under all codes. These standards are to be formulated by representatives of the government, the consumers' organization and the manufacturer. Such specification bodies as the American Standards association and the American Society for Testing Materials may contribute such data as they possess and pass along their standards for consideration by the new committees, subject to review and approval, if found worthy. The A. S. T. M. was even invited to improvise simple tests, capable of application by high school or college laboratories. County consumer councils will set in motion the forces of reprisal when a consumer complains. Woe to the blast furnace when the foundryman complains and the local high school laboratory sustains an indictment of two pigs in that last car load that were two points off in silicon. But what if the casting consumer takes action for mis-labeling because the pattern was rapped too hard and the weight is two pounds over on that 500 pound job? The difficulty of separating the population into two distinct groups, producers and consumers, is evident. One salty technician who heard these proposals for consumer standards suggested a bird as insignia for the ultimate consumer—the sparrow.

What's New in APRIL

METHODS employed in the Ford foundry in casting crankshafts for the V-8 engine explained in detail (page 14). Melts gray iron in an air furnace to obtain special properties (page 18). Code authorities encounter difficulties as they ponder compliance problems (page 21). Interest in use of alloys results in survey of zirconium in cast iron (page 22). Steel foundry spins the molds after pouring to aid feeding and increase density of the metal (page 26).

Fig. 1 (Left)—Each ladle holds sufficient metal to pour four molds. Fig. 2 (Below)—A typical group of castings with attached gates and risers and resting on the risers

Ford Foundry Casts V-8 Engine Crankshafts

By PAT DWYER

DEMAND for strength, lightness, precision; ability to withstand extraordinary variations in temperature and to function smoothly over a period of years, coupled with keen competition between various manufacturers, have resulted in practically revolutionizing methods and practices in foundries devoted to the production of automotive engines.

Automotive foundry equipment and technique developed to meet the most exacting requirements on a mass production basis, have exerted a profound influence on the entire foundry industry. Constant pressure on engineers and foundrymen to reduce weight, increase physical properties and cut manufacturing costs have keyed inventive faculties to the highest pitch and in many instances, have forced plant managers, metallurgists, technicians and operating men to venture into hitherto unexplored fields for a solution of problems formerly considered outside the range of practical accomplishment.

The past decade in foundry history probably will show a greater list of innovations and improvements than is shown in the entire period dating back to the attempt of the first hardy and independent thinker who conceived the idea of reducing metal to the liquid form and pouring it into a stone mold for a spear head, instead of laboriously pounding a lump of metal into the desired shape with a stone hammer.

Continued growth and expansion of the Ford Motor Co. activities are due in large measure to the pioneering spirit of the presiding genius, a spirit which realizes that nothing is so perfect that it cannot be improved to some extent. A fairly extensive measure of recognition also is due a staff through whose skill and knowledge the impossible becomes possible.

Intensive, incessant and insatiable investigation is carried on by the personnel of a research department. Radical, and at times, extraordinary ideas are received or conceived here and after due—and in many instances, prolonged—periods of incubation are translated into actualities. The incubation period in the laboratory usually is followed by an experimental period in

the shops, where unforseen obstacles pop up occasionally with the proverbial perversity which is peculiar to inanimate objects.

For example the present cast crankshaft for the V-eight car produced in large numbers at the River Rouge works of the Ford Motor Co., is the outcome of intermittent experimental work over the past five years One line of experiment was devoted to a method of molding the castings, while a second line, which necessarily had to synchronize with the first, was devoted to the development of a suitable metal. Early experiments covered green sand, dry sand and permanent molds and various combinations of all three. The metal combinations included a wide range of mixtures. That the proposed objective has been attained is apparent from the fact that the cast crankshafts as now produced are superior in practically every respect to the forged steel shafts formerly placed in Ford cars.

Fig. 4—A set of 16 coreboxes mounted on a turntable pass under a sand slinging machine in the background. The cores are rolled over and removed as they pass the devices shown in the foreground

Before the present crankshaft was placed on a production basis and fed as a routine product into the assembly line, approximately 2000 shafts had been placed in cars where their behavior could be checked closely. They were placed in service cars and others operated by the company and in outside cars operating in the Detroit area and easily accessible for purpose of examination and record.

The majority of these crankshafts have been in constant service for at least two years while others have been in use for varying periods up to five years. Up to the present none has failed in service, none has shown distortion or appreciable wear, and none has shown defect of fiber stress or crystallization, a form of defect usually associated with ferrous metal subjected to constant revolution and vibration and commonly known as fatigue of metal.

Immune to Fatigue Factor

Composition and subsequent heat treatment of the casting apparently renders the metal immune, at least within practical operating limits to the fatigue factor which materially lowers the life expectancy of a forged steel shaft. Long life of the cast shaft is ascribed to the comparatively high carbon content, 1.25 to 1.40 per cent, and to the form and distribution of the carbon throughout the mass. Also to some extent the carbon provides a certain amount of lubrication.

Metal in the cast crankshaft partakes somewhat of the characteristics of steel, of gray iron and of malleable iron and therefore cannot be classified under any of these headings. For the same reason the carbon evades any present classification, but to a certain extent may be compared to the temper carbon in malleable iron.

In this connection it is interesting to note that the use of alloys in ferrous foundry practice has increased so rapidly in recent years that nomenclature has lagged behind. The American Foundrymens association at present has a committee working on nomenclature for the wide variations of steel castings. A committee for a similar purpose in the malleable field is in process of formation. Eventually, no doubt, a suitable nomenclature will be evolved to differentiate accurately between mixtures with a gray iron base, but in which

Fig. 3—Cores are taken from storage racks at left and assembled in stacks on the conveyor at the right

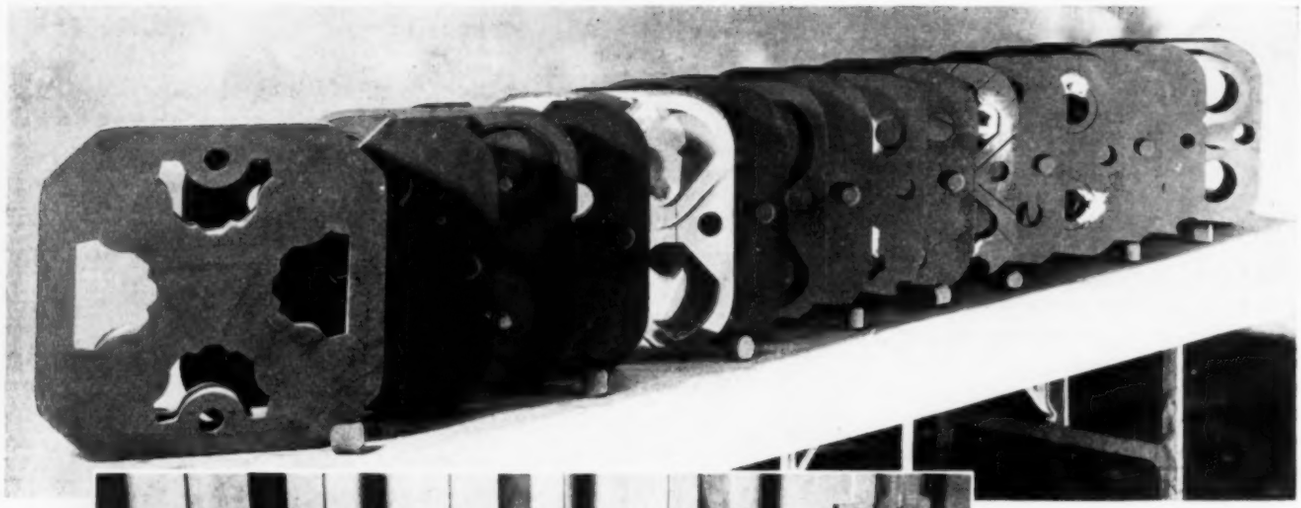


Fig. 5 (Above)—Each set of cores is made up of 16 sections. Fig. 6 (Left)—Each stack of cores is bound together by four bolts extending from the conveyor plate on the bottom to the hinged cover plate on top

the physical properties are changed by the addition of various alloys.

Metal charge for the cast crankshaft is made up of approximately 50 per cent steel scrap and 50 per cent return crankshaft scrap, that is metal from the gates and risers. Suitable amounts of various alloys are added to produce a metal of the following analysis: Carbon 1.25-1.40 per cent; manganese 0.50-0.60 per cent; silicon 1.90-2.10 per cent; chromium 0.35-0.40 per cent; copper 2.50-2.75 per cent; phosphorus 0.10 per cent maximum; sulphur 0.06 per cent maximum. Patents have been applied for covering the mixture and the method of molding.

At this point it may be pertinent to refer to an article by C. T. Eddy in the February 1934 issue of THE FOUNDRY dealing with the effect of copper on cast iron. The investigation was carried on at the Michigan College of Mining and Technology, Houghton, Mich. The author discusses the subject as follows:

Copper in common with silicon and nickel decreases the tendency of cast iron to chilling. It assists the decomposition of primary cementite or prevents its formation. This effect of assisting graphitization together with the change of the pearlite to sorbite or a higher form in the matrix and the strengthening of the ferrite because of dissolved copper, results in a hard strong iron which because of the absence of free cementite possesses good machinability. Copper refines the austenite grains in addition to refining the graphite and improving the distribution. The combined effect is a gray iron of much closer texture since the pearlitic structure apparently is inherited from the austenitic grains. The metal shows a marked increase in brinell hardness and resistance to certain forms of corrosion.

Metal Passes Through Duplexing Process

Originally the metal for the Ford crankshafts was melted from a cold charge in an electric furnace, but recently a duplexing method has been developed in which the metal is melted in the cupola, tapped into an air furnace and then drawn off as required. The air furnace has a holding capacity of 30 tons. Each of the two cupolas has a melting capacity of 14 tons per hour, sufficient to supply metal for an anticipated production of 4800 crankshafts per day. The foundry operates on three 8-hour shifts per day and each cupola is in blast alternately for 16

hours. While one cupola is in blast, the other is cooled and repaired.

A long curved trough or spout is connected at one end to the breast of the cupola. Both spouts are merged into one at some distance from the cupolas and the single spout continuation is connected to an opening at the side and near the back or stack end of the air furnace.

Temperature and composition of the metal may be controlled closely in this furnace. Obviously also the composition of metal prepared in large volume on a comparatively shallow hearth, will approach absolute uniformity. A quick test taken at frequent intervals provides the necessary check in maintaining the metal at the required temperature and analysis.

Fig. 8—Slight ridges marking the joints between the core sections are removed on an automatic grinder in which the wheel accommodates itself to the shifting contour of the revolving crankshaft casting

Metal is taken from the furnace in 1500-pound capacity ladles suspended from chain hoists on a monorail extending from the furnace to the pouring station near the conveyor on which the molds are carried. Each ladle of metal is sufficient to pour three molds, each mold containing four crankshafts.

The comparatively massive proportions of the gates and risers may be inferred from the fact that the four clean castings weigh 260 pounds, while the total amount of metal poured in each mold is 421 pounds. At a temperature of 2500 degrees Fahr., the pouring time for each mold is 45 seconds.

Each mold is made up of 16 flat core sections in stacked formation. The crankshafts are poured in a vertical position from a large central runner connected by suitable gates at a point about half way between the top and the bottom. The top of each crankshaft is expanded to a diameter of 4 inches to form a feeding riser which extends to the top of the mold. The relative size of the risers may be noted in Fig. 2.

Fig. 7—Castings readily are broken from the somewhat elaborate gate ensemble made up of a pouring basin, sprue, central auxiliary sprue and feeder, and reservoir from which a single gate enters each casting

Cores are made on two adjoining equipment units in each of which the principal features include a 20-foot waist high revolving work bench, a stationary type sandslinging machine made by the Beardsley & Piper Co., Chicago, a conveyor system for the sand and another for the core plates; automatic clamp, rollover and drop plate machines made by the International Molding Machine Co., Chicago; and a set of 16 aluminum coreboxes in which boss-like projections attached to the bottom form the necessary mold openings in the cores.

The core sand mixture contains 60 per cent new sand and 40 per cent reclaimed sand, bonded with oil and with a small amount of a proprietary dry binder to furnish the necessary (*Please turn to page* 47)

Melting Gray Iron in Air Furnace

Unit more commonly applied to production of iron with less than 3 per cent carbon

By DUNCAN P. FORBES
Gunite Foundries Corp.

THE air furnace, or reverberatory furnace, has been in use a great many years for the melting of several different metals, and one of the earliest applications was in the gray iron field to produce castings of high strength. Without going into the history of the air furnace, it is interesting to consider the furnace in its present form and also the nature of the gray iron which now is being produced in it in this country.

Air furnaces fall into three general classifications, depending on the type of fuel used in the melting operation. The type of furnace which has been in use the greatest number of years is that using hand-fired coal for fuel. In general design, a furnace consists of a more or less rectangular hearth with a fuel combustion chamber at one end and a stack at the other end.

When hand-fired coal is used, the combustion chamber takes the form of a fire-box fitted with grate bars and equipped with a blast pipe below the grate bars for forcing air through the fuel bed, which is from 12 to 18 inches in thickness. Coal used is usually of high B.T.U. content, with a high percentage of volatile matter, and the resulting flame is rich in unburned gas and carbon monoxide.

The flame passes over a low bridge wall where a quantity of secondary air is blown in through tuyeres in a wind bung located over the bridge wall. This secondary air completes the combustion of the raw, gaseous flame and directs the resulting high-temperature flame down upon the charge to be melted and upon the molten bath which results therefrom.

The flame travels through the furnace rather rapidly, heating the charge by radiation as well as by conduction, and passes out to the stack over a low bridge wall at the rear end of the furnace.

The heat balances of air furnaces and the melting efficiency have been covered completely in previous articles dealing with that subject. For our purposes it only is necessary to describe the types of furnaces as an introduction to the consideration of air-furnace cast iron, which is to follow. It is sufficient, in passing, to say that from a fuel efficiency standpoint the air furnace is extremely wasteful.

Within the last 20 years the use of pulverized coal and fuel oil have become almost universal in air furnaces in the malleable industry, with the greatest popularity being shown the furnaces using pulverized coal. In construction, the pulverized coal furnace differs from the hand-fired coal furnace in that the fire box is eliminated and in its place one or more pulverized coal burners are located in the end wall of the furnace, blowing the pulverized coal flame downward at a slight angle upon the hearth. The longitudinal section of a pulverized coal fired furnace is shown in Fig. 1. No secondary air is necessary to complete the combustion.

The oil-fired furnace is similar to the pulverized coal furnace, except that a conical combustion chamber about 6 or 8 feet in length usually is added at the firing end of the furnace to confine the oil flame and to assist the combustion of the oil spray and the air blast. Most of the oil-fired furnaces in use at the present time provide means of admitting secondary air to the flame at the end of the combustion chamber through tuyeres in a wind bung, the amount of

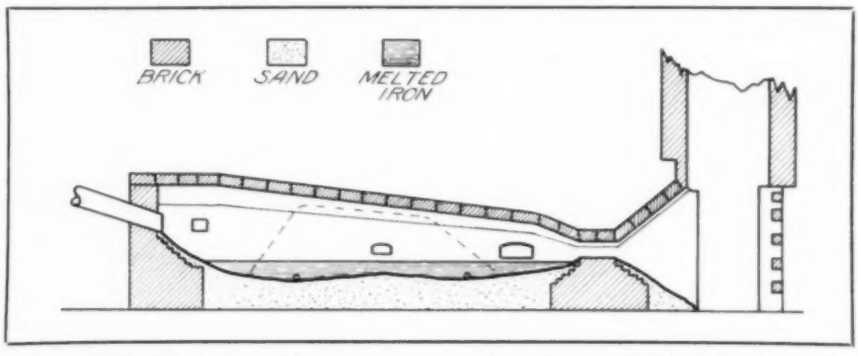


Fig. 1—Pulverized coal fired air furnace showing longitudinal section with steelwork omitted. Dotted line shows cold storage

air admitted at that point in relation to the amount that is blown in with the oil spray varying widely among different operators. Successful installations are in operation where the secondary air varies from one-third to two-thirds of the total amount of air used.

Without discussing the merits of one type of furnace over another, it can be stated that the oil-fired and pulverized-coal-fired furnaces are more popular than hand-fired coal furnaces because of their rapid rate of melting and the fact that a low-price charge can be used to obtain a given ultimate analysis. Fuel economy is also an important factor.

In America, air furnaces are used principally for the production of white-iron castings which are later to be annealed into malleable iron. However, for many years high-grade gray iron also has been produced by the air furnace process because that process offered a simple means of obtaining low-carbon metal. In recent years, with the developments in metallurgy due to the use of alloys and electric-furnace melting, air-furnace cast iron has assumed greater importance. This metal is called gun iron, due to its use in ordnance in the middle of the last century. Gun iron is defined by Webster as "cast iron of extra-ordinary strength, prepared by melting in an air furnace instead of the cupola."

Melting in the air furnace is accomplished by first removing a section of the roof bungs or firebrick arches, which gives access to the hearth section of the furnace. The charge of metal is deposited on the sand or brick bottom of the hearth and is distributed so that melting will be uniform across the width of the hearth. The charge usually consists of remelt from previous heats, purchased scrap, and pig iron. Table I shows the typical charge. After the charging operation is complete, bungs are replaced and sealed with fire-clay. The fire then is lighted in the fire box, or the pulverized coal or oil burners are lighted.

Table I

Analysis of Charge For Hand-Fired Air Furnace

Material	Lbs.	Per cent of Charge	Si Per cent	C Per cent	Mn Per cent	S Per cent	P Per cent
Remelt.....	15000	50	2.00	2.90	0.45	0.060	0.160
Pig Iron....	7500	25	1.50	4.00	0.80	0.035	0.180
Pig Iron....	7500	25	4.40	4.00	0.94	0.022	0.150
Total Charge...	30000	100	2.48	3.40	0.76	0.045	0.163
Iron Tapped	28500	95	2.03	2.90	0.51	0.063	0.165
Per cent Loss of Elements....			18.1	14.7	32.9	40.0*	1.2*

*Gain

Table II

Time Schedule for 15-Ton Heat, Hand Fired

Time	Operation
0:00	Light fire.
0:45	Turn on bottom blast and partial top blast.
1:45	Top blast increased to full.
4:45	Stir and skim slag.
5:45	Stir and take sample for analysis.
6:15	Stir and pour fracture specimen.
6:45	Stir and tap furnace.
6:50	Reduce top blase.
7:30	Furnace empty.

Table III

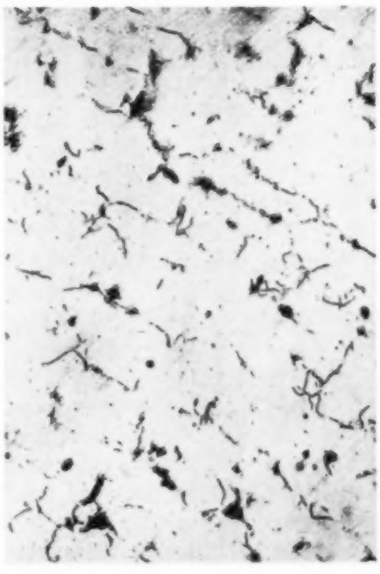
Analysis and Physical Properties of Typical Iron

Sample	Si Per cent	C Per cent	Mn Per cent	Ni Per cent	Cr Per cent	Mo Per cent	Transverse Strength,* pounds.	De-flection in.	Brinell Hardiness
1	2.04	2.80	0.62	....	....	....	6100	0.19	196
2	2.20	2.54	0.54	....	....	....	6000	0.17	220
3	1.96	3.10	0.58	....	....	....	5600	0.18	187
4	2.04	2.80	0.62	....	0.42	....	6300	0.15	235
5	2.04	2.80	0.62	1.00	....	....	6300	0.16	217
6	2.04	2.80	0.62	....	....	0.80	6600	0.21	212

*Transverse tests were conducted on a bar 1¼ inches in diameter, broken on 12-inch centers.

Melting technique varies widely through the plants using air furnaces, some operators preferring to melt as rapidly as possible with a sharp, hot flame. Some prefer to use a soft flame and take a longer time to accomplish the melting-down stage of the operation. Others prefer to soak the charge at a moderate temperature, to preheat it to the bottom of the hearth before any great amount of melting occurs. After the charge has been fairly well preheated, melting then is conducted as rapidly as possible.

When the charge is in the all-molten condition, it is almost universal practice to fire as hard as possible to give the metal enough superheat for pouring in the shortest possible time. This will require



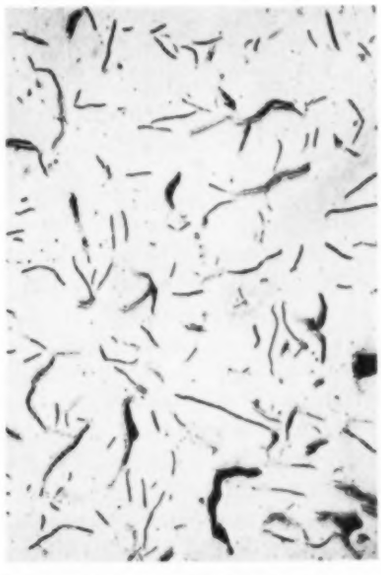


Fig. 2 (Left)—Micrograph of air furnace iron, carbon approximately 2.40, unetched X100. Fig. 3 (Right)—Air furnace iron approximately 2.80 per cent carbon, unetched X100

from 1 to 2 hours, and the molten metal usually is stirred and skimmed several times during this period. Table II gives a time schedule for a 15-ton heat in a hand-fired furnace.

Some operators prefer to leave the slag on the metal until just before tapping, thinking thereby to protect the metal from the oxidizing action of the flame. However, in most plants the metal is skimmed one or more times during the heating-up period, on the assumption that the

Fig. 4—Air furnace iron with approximately 2.80 per cent carbon, etched with nital, X100

presence of slag on the surface of the metal would delay the heating-up period to such an extent that there would be no gain, as far as avoidance of oxidation is concerned.

When the metal is in the molten condition and has become sufficiently superheated, it is customary in all plants to pour a specimen or bar which can be broken so that the melter can examine the fracture. In some plants chemical analysis also is made from specimens taken at that time. When the tests have been completed, if the metal is of a correct composition and temperature, pouring can begin immediately. If the metal is not of correct analysis and fracture, the melter can make the necessary additions, of steel, alloys or petroleum coke to obtain the exact composition desired.

In the air furnace the carbon, silicon and manganese are being oxidized at all times, and frequently, if tests indicate a surplus of those elements, an additional 10 or 15 minutes of firing will bring the metal to the desired analysis. When melting with pulverized coal, some of the more coarse coal particles often will fall into the bath and be absorbed, resulting in a slight pick-up of carbon which will conteract the loss due to oxidation. In general, this carbon pick-up is looked upon as dangerous, although under most circumstances no harm would result from a moderate amount of this carbon absorption.

This description of the melting operation is brief, and it is not too much to say that the experience and technique of the melter will have a great bearing on the uniformity and quality of the resulting metal.

The important points about successful air-furnace melting which must be observed are: Design and proportions of the inside of the furnace; selection of materials and melting stock; scrupulous adherence to a definite program of operation; skill and experience in testing the metal before tapping, and judgment in applying correctives, if needed; attention to resulting physical and chemical properties of metal from each heat, so that minor variations can be corrected in subsequent heats before serious divergence from standard practice occurs.

Refines and Superheats Metal

A variation of operation of the air furnace occurs when the air furnace is used only for refining and superheating the metal instead of for melting. Great progress has been made in the United States in duplexing gray iron and malleable iron, where the metal is melted in a cupola and refined in an electric furnace or an air furnace.

To understand the reasons for duplexing, it is necessary to consider briefly the capabilities of a cupola. The cupola provides the least expensive known means of melting iron. The thermal efficiency is excellent, and the furnace, if the investment involved is considered, has a high melting rate. For melting small heats the cupola is not particularly efficient, but where melting can be continued for many hours the cost is low.

A cupola can be operated either with a continuous flow of metal at the spout or by intermittent tapping of individual charges. In either case, the analysis of the metal flowing from the spout is not uniform, due to the fact that the charge does not melt uniformly and that the carbon and silicon may vary over a considerable range. This variation is minimized if individual charges are tapped intermittently, because the metal which accumulates on the bed of the cupola has an opportunity to become somewhat uniform.

If we are to consider only high-test iron, which is relatively low in carbon, there is a decided advantage in having the cupola deliver metal continuously, since a minimum time then is allowed after melting for carbon pick-up from the coke bed.

In cupola operation, metal passes from the solid to the molten condition in a remarkably short period of time. In the melting zone the small drops of metal (*Please turn to page* 48)

Ponder Compliance Problems

Code authorities of foundry industry face important perplexities in administration

TWO perplexities of major importance engage the attention of code authorities in the four main branches of the foundry industry. The administration, following the conference of code authorities in Washington during the week of March 4, has engaged in extensive study of open price reporting, as embodied in a number of approved codes. Meantime a stay was applied against the more recent codes, holding in abeyance any request for a waiting period between the time of filing prices and accepting orders.

The steel foundry industry, since the effective date of its code, has operated under the open price reporting plan. A waiting period of 10 days is believed by those operating under the code to be effective in checking ill considered price cutting that proved so destructive during the past several years. While no restriction is placed upon a price which may be filed, it is impossible for a buyer to induce a bidder to cut below a competitor's figure on a specific job for immediate acceptance. Of course, the filing of a low price and notice thereof may serve to induce others to file to meet the price when it is announced, but the waiting period prevents precititate and ill considered action.

Codes Offer Welcome Relief

The malleable code provides for a fair and reasonable cost schedule, accepted by some as constituting a price *floor*. This schedule has been prepared and public hearing has been held. Gray iron and nonferrous codes call for uniform cost accounting and forbid selling below sellers' costs.

While the immediate effect of a ruling permitting open pricing may not be evident in all branches of the industry, the influence of a recognition of the sound principles involved will be of immeasurable value to jobbing castings makers. Numerous lines of manufacture now seeking relief through open pricing are large consumers of castings. Elimination of destructive pricing in these fields will afford relief to the foundry industry from some of the pressure and demands for lower and lower prices that invariably lead to chiseling castings prices.

The second major problem, tossed into view at the code authority conference, is that of securing support and compliance from individual firms. Steel and malleable foundries, practically without exception, are giving thorough cooperation to their code organizations and are contributing their proportionate share to the expenses involved. However, the gray iron and nonferrous jobbing industries face a heavy organization problem. The large firms and those that formerly have been identified with trade association activities are co-operating. Those that still remain apathetic, either through lack of interest or inability to appreciate the necessity for participating, constitute a major problem for the code authorities of the two branches of the foundry industry, mentioned.

More Co-operation Needed

The administration has given no positive assistance in the organization problem. While a manufacturer may be subject to every provision of the code of his industry, subject to regulation on labor and fair trade practice regulations alike, his participation in promoting compliance and in supporting his industry financially is largely a matter of his own free will and accord. Code authorities complain that they can resort only to the co-operative spirit, or the pressure of opinion of competitors or customers to secure support that is badly needed.

One important effect of the March code authority conference has been to secure a greater measure of appreciation of industry's problems by the administration. Manufacturing interests have become more vocal and apparently Washington appreciates for the first time that such viewpoint must be considered in making its plans work.

Two important announcements have been made by General Johnson with relation to code administration. Advisors from the consumer and labor boards are being designated to work with the administration member of each code authority. These advisors will not be members of the code authority in any case, will attend meetings only on invitation, but will have access to all proceedings and will have the right to appear before code authorities to make statements upon specific measures.

The second order (*Please turn to page* 53)

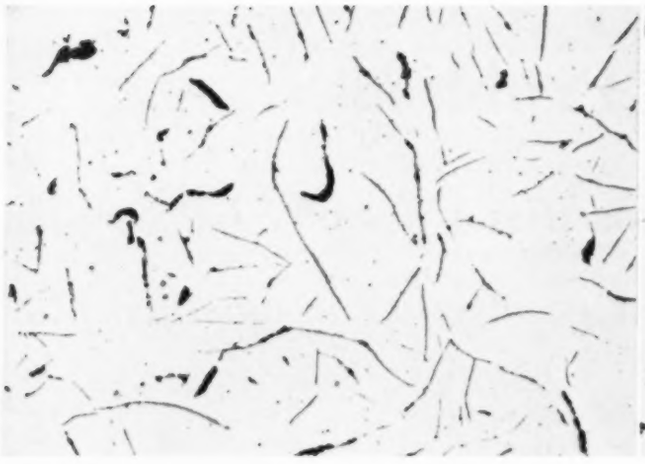


Fig. 1 (Left)—Micrograph of plain cast iron, X100 unetched. Fig. 2 (Right)—Same iron with 0.70 per cent zirconium added, X100, unetched

Effect of Zirconium on Cast Iron

Small amounts of alloy act as purifying and deoxidizing agent and graphitize white iron

By REBECCA HALL
Metallurgist, Chicago

ZIRCONIUM was first noticed as an alloy element for steel and cast iron during the war. Some experiments on zirconium in steel were carried out at that time, and subsequent work has shown its powerful deoxidizing and denitrogenizing action when added to steel.

However, little has been published on the effect of zirconium in cast iron. Ten years ago, it was either ignored or dismissed with the phrase "no beneficial effects." Even so recently as 1930, it was stated that zirconium has no essential influence on cast iron. It is really only in the past few years that the remarkable action of zirconium has awakened the interest of the gray iron industry.

Dr. Richard Moldenke was one of the first to study the effect of zirconium in cast iron. He

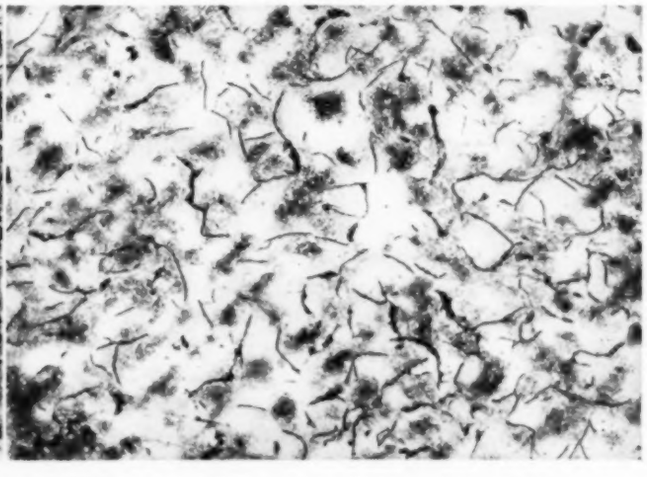


Fig. 3 (Left)—Plain cast iron, X100, etched. Fig. 4 (Right)—Same iron as in Fig. 2, X100, etched

found that when present in the usual amount for deoxidation purposes, 0.10 per cent, it increased breaking strength and deflection in both white and gray iron mixtures. In the smaller percentages, the metal gave good results as to melting and deoxidizing, but in larger percentages, the iron chilled so that it was hard to pour. (More recent work indicates that although the ladle additions may cause the iron to appear cold, its fluidity is in fact increased). According to Dr. Moldenke, the most important effect of zirconium in cast iron was its "'closing the grain." It is said that a decided refinement of grain structure results from the deoxidizing action of zirconium, which may explain the improvements observed in physical properties.

Other references to zirconium indicate that it raises the resistance to impact and hydrostatic pressure in cast iron to a great degree, as might be expected from the close grained structure. Another important effect is the influence of zirconium on graphitization, which was noted by Oliver Smalley. He found that 0.75 per cent silicon zirconium (35 per cent zirconium, 45 per cent silicon) and 0.50 per cent ferrosilicon was an effective graphitizer, giving a dark gray fracture indicative of great toughness.

In tests to determine the effect of zirconium on the physical properties of cast iron, such percentages of alloys were used as to give zirconium additions between 0.10 and 0.50 per cent, which is said to be the most beneficial for cast iron. Zirconium alloys were used, silicon zirconium (zirconium 35 to 40 per cent, silicon 50 per cent), and zirconium ferrosilicon (zirconium 12 to 15 per cent, silicon 40 per cent), since these are absorbed much more easily by the liquid iron than is ferrozirconium. The crushed alloys were added to the stream during the filling of the ladle, just as chromium and nickel commonly are added.

Since all the zirconium alloys used contained large percentages of silicon, checks were prepared on irons of the same base composition, keeping the silicon content the same as in the zirconium alloyed irons by additions of ferrosilicon. This was done so that the effect of the zirconium might not be obscured by the effect of higher silicon. In using the previously mentioned zirconium alloys, the composition of the melt should be held rather low in silicon to obtain the full benefit of the zirconium.

Standard 1 x 2 inch test bars were used. Ultimate modulus of rupture was calculated from the breaking load of the bar on 24-inch supports. Ultimate deflection and ultimate modulus of elasticity were taken at the breaking load. Values for the brinell hardness number are the average of five places on the test bar.

Results of some typical test bars are shown graphically in the accompanying illustrations. Fig. 5 shows the effect of 1 per cent silicon zirconium (an addition of 0.35 to 0.40 per cent zirconium) on the ultimate modulus of rupture of an electric furnace iron of the following composition: total carbon 2.85 per cent, silicon 1.92 per cent, sulphur 0.043 per cent, manganese 0.58 per cent, and phosphorus 0.06 per cent.

Fig. 6 illustrates the effect of zirconium on the ultimate deflection. The decrease in ultimate modulus of elasticity caused by 1 per cent zirconium addition is shown in Fig. 7. Fig. 8 charts the increase in drop test values, indicative of higher impact strength and greater toughness. The slight effect of zirconium exercises on the brinell hardness number of the cast iron is illustrated in Fig. 9.

Effect of zirconium when the silicon content is kept constant by additions of ferrosilicon, on an iron with the base composition of total carbon (*Please turn to page* 54)

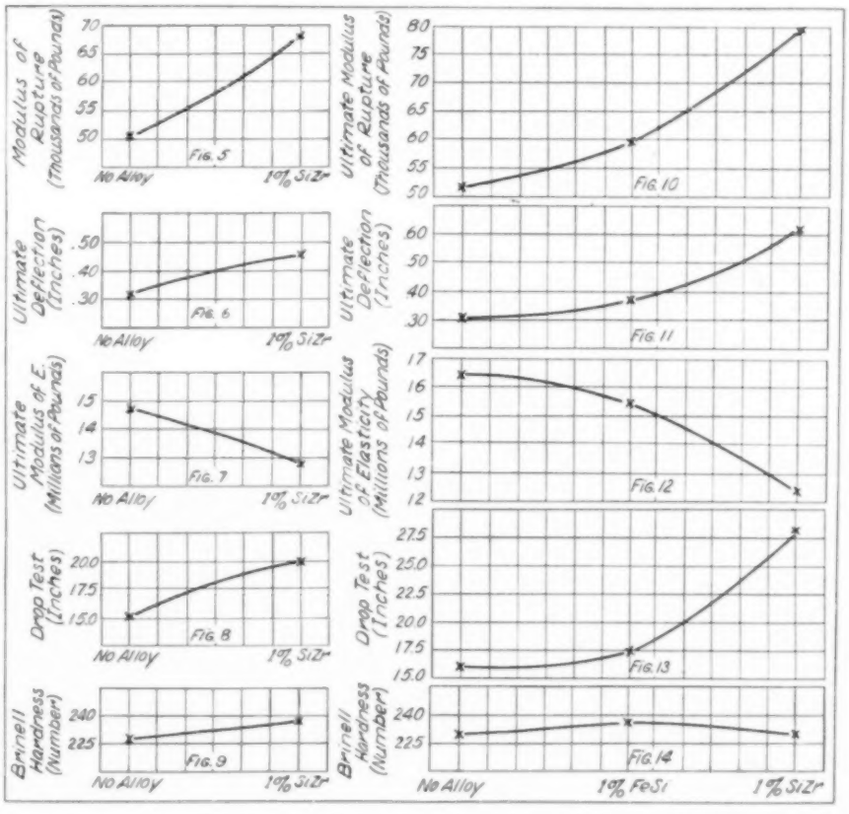


Fig. 5—Effect of 1 per cent silicon zirconium on ultimate modulus of rupture. Fig. 6—On ultimate deflection. Fig. 7—On ultimate modulus of elasticity. Fig. 8—On drop test values. Fig. 9—On brinell hardness. Fig. 10—Ultimate modulus of rupture on plain iron, and with 1 per cent ferrosilicon and 1 per cent silicon zirconium additions. Fig. 11—Ultimate deflection. Fig. 12—Ultimate modulus of elasticity. Fig. 13—Drop test. Fig. 14—Hardness

Pouring Temperatures of Bronzes

Important factor influencing mechanical and metallurgical properties of casting

By EDMUND R. THEWS

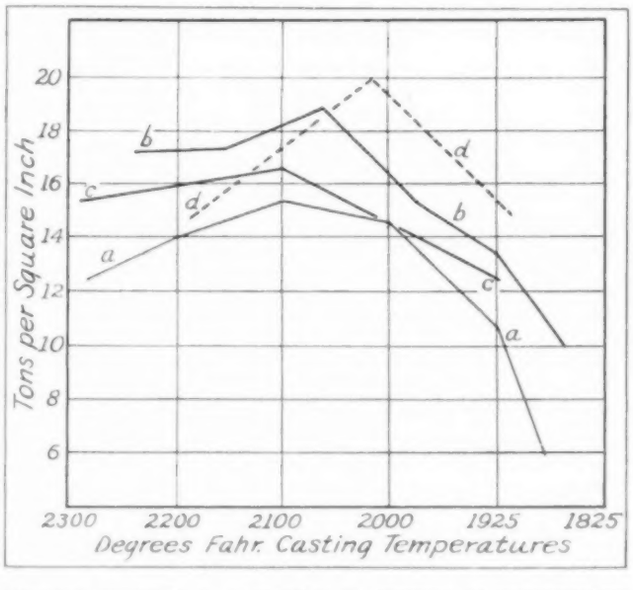
ULTIMATE strength of a number of bronzes of compositions listed in Table IV, is indicated in the accompanying illustration. The data are from *The Metallurgy of Bronze* by Dews. It is obvious that satisfactory results cannot be obtained with pouring temperatures too high or two low. It also is evident in many cases that the tensile properties as well as elongation, elasticity and other factors are affected much more by decreasing temperatures below the optimum temperature than by corresponding temperature increases beyond the optimum point. The only exception to this rule is the hardness which increases regularly with falling temperatures.

Low Pouring Temperature Deleterious

Table V gives some mechanical values of a bronze containing 0.084 per cent phosphorus as discussed in *Metal Industry*, London, Sept. 26, 1924. Again it is shown that at an optimum pouring range of about 2000 to 2075 degrees Fahr., a temperature but 60 degrees Fahr. lower than the optimum minimum will deteriorate the properties of the bronze much more noticeably than a corresponding excess of temperature. Similar to the hardness value, the density of bronze castings increases with decreasing pouring temperatures.

Annealing the castings at a temperature of 1200 degrees Fahr. and quenching from that temperature improves the strength, yield point and hardness values of bronzes and lowers the elongation, best results being obtained if the bronzes are cast within a temperature range of 2000 to 2150 degrees Fahr. With lower casting temperatures the maximum load and, particularly, the elongation of the annealed and quenched castings will reach minimum values. Thus, a 84/16 bronze (0.05 per cent phosphorous) which on casting at about 2100 degrees Fahr. and quenching from an annealing temperature of 1200 degrees Fahr. exhibits a maximum load of 36,000 pounds per square inch, a yield point of 25,000 pounds per square inch, and an elongation of 8.5 per cent, will at a casting temperature of about 1900 degrees Fahr. and after the same heat treatment yield the following values: Maximum load: 17,000 pounds per square inch; yield point: 16,000 pounds per square inch; elongation: 1 per cent. The brinell hardness at the same time rises from 83 to 101. It is obvious, therefore, that while the effects of casting temperatures of bronzes may be modified considerably by proper heat treatment, it is difficult to correct the ill effects of unsuitable pouring temperatures later on.

Considering the temperature ranges best suited for casting the various types of bronze alloys attention is called to the fact that there appears to be little uniformity of opinion concerning optimum pouring temperature, even for alloys of similar composition. However, it also will be found that if the various temperature ranges are compared, practically all of them will include a certain narrow temperature range which may be considered the standard temperature range for casting the type of alloy in question. Taking, for instance, a zinc-bronze of the type 88/10/2, the author has collected the fol-



Ultimate strength of a number of bronzes of compositions given in Table IV

lowing temperature ranges given in American, German, and English literature:

	Degrees Fahr.
a)	1870-2150
b)	1960-2150
c)	1960-2280
d)	2000-2300
e)	2010-2300
f)	2020-2300
g)	2030-2220
h)	2100-2200
i)	2100-2250
k)	2100-2200

Comparing these temperature ranges, it is found that in spite of their obvious disagreement they all include a range of 2100 to 2150 degrees Fahr., which may therefore be regarded as representing a suitable base for determining the proper casting temperature in each particular case, the type of mold used, size and shape of the casting, the mechanical properties desired, etc. influencing the choice of pouring temperature, of course.

Table IV

Composition of Several Bronzes

	Copper Per Cent	Tin Per Cent	Zinc Per Cent	Lead Per Cent	Phosphorus Per Cent	Nickel Per Cent
a)	84.50	15.30	0.10	.....	0.10	.....
b)	88.00	6.10	5.30	0.50	0.03	.....
c)	89.95	10.00	.....	.....	.....	.....
d)	86.70	7.50	4.10	1.35	.....	0.40

Table V

Mechanical Properties of Bronzes

Casting Temperature Degrees Fahr.	Condition	Yield Point tons per sq. in.	Maximum Load Tons per sq. in.	Elongation on 2 in. per cent	Brinell Hardness 1000 kg. to mm. ball	Izod Impact, Ft.-lb.
2260	As cast	12.5	12.5	1.0	82	21.0
2145	"	12.6	14.4	1.5	88	25.5
2085	"	12.0	15.4	3.0	99	14.0
1995	"	14.3	14.7	1.0	111	9.0
1940	"	12.4	12.4	0.5	114	8.5
1875	"	6.6	6.6	nil.	118	10.0

The gas contents of bronze castings also are determined largely by the casting temperatures, although the numerous variables influencing the absorption and retention of gases often will render recognition of the direct relation between these two factors difficult. This is illustrated by the fact that in contrast to the generally accepted opinion that the gas porosity of bronzes becomes less pronounced with decreasing casting temperatures, a number of authorities would remedy bad cases of gas porosity by raising the casting temperatures somewhat. Francis W. Rowe in *Metal Industry*, London, Dec. 26, 1924 states "that whenever castings exhibit blow holes, the first thing that should be done is to try the effect of a casting temperature 50 or 100 degrees Cent. (90 to 180 degrees Fahr.) higher.

Effect of Gases Varies

A similar divergence of opinions exists concerning the influence of gas contents of bronzes on the mechanical properties. General opinion holds that the quality of the castings decreases with rising gas contents. However, this opinion is not shared by well known authorities such as Carpenter, Elam, Guillemin, Delachanal, etc. whose experiments have shown that fair as well as faulty castings usually exhibit about equal gas contents, and that the differences observed are too small to explain the presence of porosities in some castings and their absence in others.

However, Guillemin and Delachanal determined certain qualitive differences in the action of the various gases in question. They found, for instance, that good castings contained a comparatively large percentage of hydrogen gas—with correspondingly low carbon monoxide and carbonic acid contents while the gas contents of faulty bronze castings contain considerable percentages of the carbon oxides. These findings are in direct contrast to the results of Edward J. Daniels who found that carbon monoxide and dioxide as well as nitrogen contents react entirely neutral toward the properties of bronze castings while large hydrogen contents may cause faulty castings. Trouble of this sort may, according to Daniels, be averted by treatment of the bronze melt with neutral gases. Nitrogen has been suggested as being the most suitable gas for that purpose. While some authorities do not agree in the nitrogen treatment to increase the density of bronze castings, it seems to be conceded generally that the strength values are improved noticeably thereby.

High Pressure Is Developed

It appears that in considering the influence of the gas contents on the quality of bronze castings the mistake often is made attributing the development of blow holes to gases absorbed throughout the melting process only, while the absorption of gases from the molding materials is ignored. In casting bronzes in sand molds, gases in question not only consist of the steam formed by moisture of sand and by air contained in the molding material but include carbon oxides from carbon compounds contained in mold washing and core mixtures as well as in organic bonding materials employed.

According to H. J. S. Kerl, *Foundry Trade Journal*, Feb. 2, 1920, a gas pressure of 10 atmospheres may be developed in filling a normal sand mold, a pressure doubtlessly sufficing to force a considerable quantity of gas into the fluid or semifluid metal filling the mold. This gas usually concentrates directly beneath the surface of the casting, and considering the short period of time taken by the bronze to solidify it is obvious that most (*Please turn to page* 53)

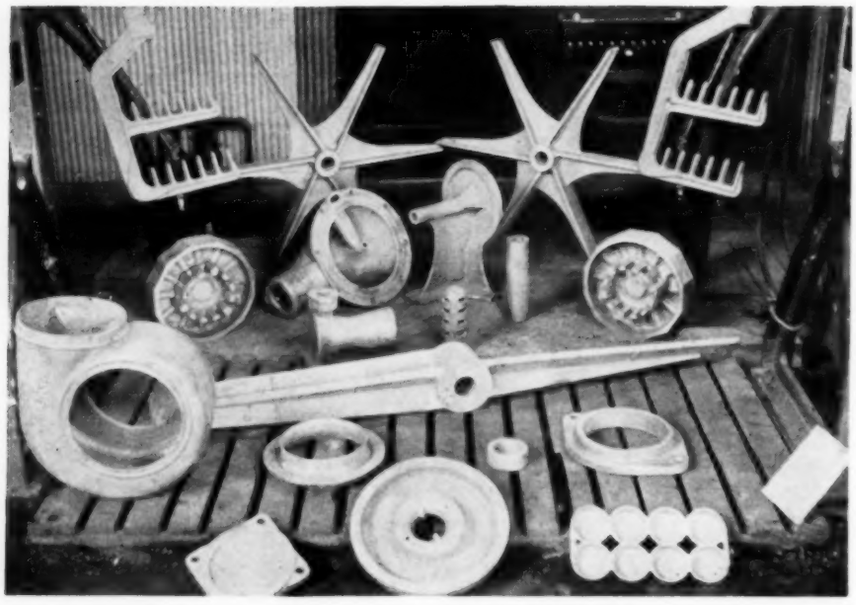


Fig. 1—A group of miscellaneous alloy steel castings made for a variety of purposes

Spins Molds After Pouring

Firm employs interesting method to obtain solidity and density in certain castings

By EDWIN BREMER

LONG experience and skill in making castings for a specific industry from an alloy iron developed after an extended experimental period often can be applied to advantage in producing an entirely different type of material. This flexibility in adapting experience to other problems is illustrated in the case of the Duriron Co. Inc., Dayton, O. As mentioned in the March issue of THE FOUNDRY, that company in May, 1912 after about a year of experimenting, placed a line of high silicon iron castings on the market in this country, which met requirements of the chemical industry.

Slightly over 18 years later, July, 1930 to be exact, the firm poured its initial heat of high alloy steel for corrosion resisting purposes. The original purpose in establishing its alloy steel foundry was to produce high grade alloy steel castings for use in its own finished products, but later that was changed so that in addition the firm does jobbing work in corrosion and heat resisting castings.

The foundry, which is of brick and steel sash construction, is 80 x 80 feet with a central bay 40 feet wide and two side bays each 20 feet wide. The ends of the building are sheet steel so that extensions may be added when necessary. Two

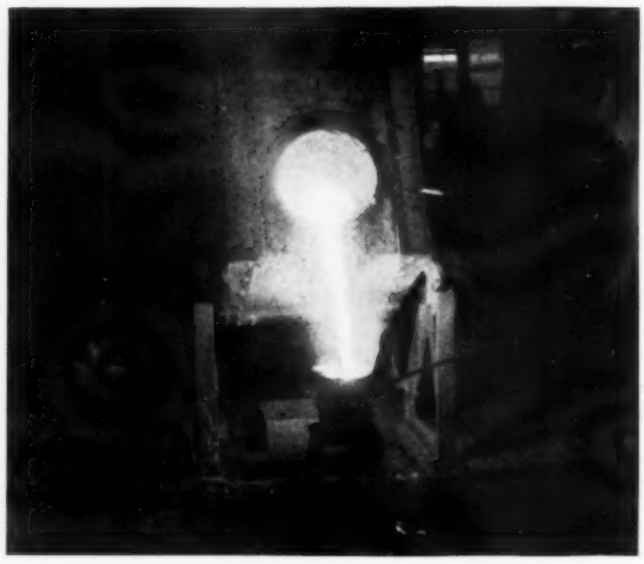


Fig. 2—Piping hot metal from the high frequency induction furnaces is poured into hand shanks or into larger ladles as required

650-pound high frequency electric induction furnaces with their generating equipment are located in one corner of the shop. The generating equipment of course is walled-off from the remainder of the foundry. Two gas-fired mold and core drying ovens which will accommodate molds up to 4½ x 4½ x 5 feet are in the adjacent corner. A 400-ampere electric arc welding and cutting machine is located in the corner diagonally opposite the ovens. Jib cranes are located at convenient points for handling molds and castings.

A wide variety of alloy steel castings are produced in the foundry, including such alloys as 18 per cent chromium, 8 per cent nickel; 18 per cent chromium, 9 per cent nickel with extremely low carbon; 18 per cent chromium, 8 per cent nickel, 3 per cent molybdenum; 26 per cent chromium, 10 per cent nickel, and 20 per cent chromium, 23 per cent nickel, 1.25 per cent molybdenum, 1.0 per cent copper, and 3 per cent silicon.

The first four alloys mentioned are made under license from Krupp-Nirosta Inc., New

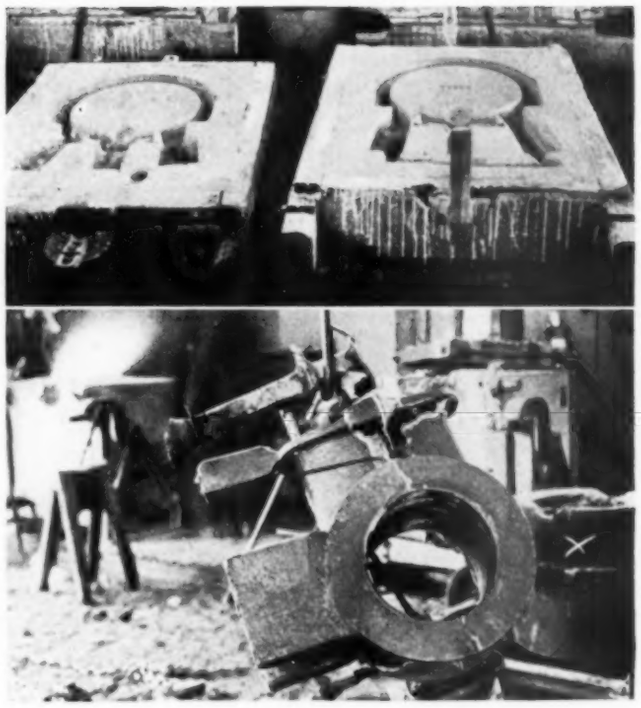


Fig. 5 (Above)—Cope and drag molds for a gate or disk for a gate valve just before closing. Fig. 6 (Below)—Gate valve casting after removal from the sand showing the gate and risers

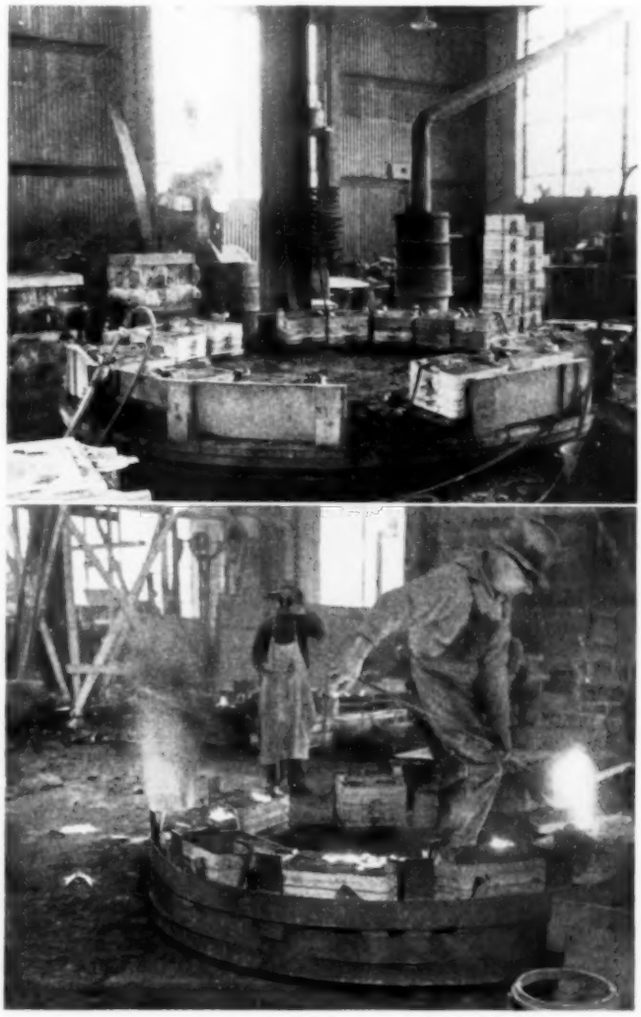


Fig. 3 (Above)—Large centrifugal pouring table with a number of molds in position ready for pouring-off. Fig. 4 (Below)—Molds are poured completely in a few seconds and then the table is rotated from 5 to 6 minutes

York, while the last one containing nickel, chromium, molybdenum, copper and silicon was developed by the firm. That alloy is sold under the trade name *Durimet* and was developed to withstand severe corrosive conditions. The weight range of the castings made by the firm is wide as may be observed from those shown in Figs. 1 and 6. In addition to the alloy steels mentioned the company also produces a special iron alloy in the steel foundry. It is resistant to hydrochloric acid and contains in addition to about 14 per cent silicon, approximately 4 per cent molybdenum, and 1 per cent nickel.

One of the unusual features of the foundry is the application of centrifugal force to obtain sound, dense castings. The method used has the same basic principle as employed in what is termed *centrifugal* casting, but the procedure of applying, or perhaps better, the time of applying centrifugal force is different. In centrifugal casting the molten metal is poured into a rapidly rotating mold revolving on a horizontal or vertical axis. In the process as applied at the Duriron Co. plant, the mold is stationary while it is being filled, and then it is rotated.

Figs. 3 and 4 are views of two rotable tables used in the operation which, by the way, is not employed on all types of castings. The tables are located in one of the end bays of the foundry opposite that containing the electric furnaces and cleaning department. One of the tables is about 12 feet in diameter and the other about 8 feet in diameter. They are mounted on central shafts and driven by electric motors. The speed of rotation is about 50 (*Please turn to page* 54)

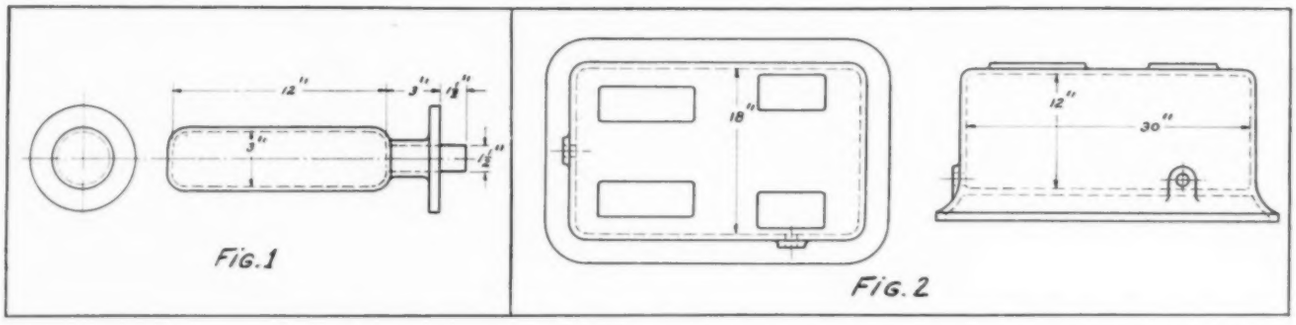


Fig. 1

Fig. 2

Fig. 1—One end of the core is supported in a print. Fig. 2—This core is held up by chaplets on the bottom and held down by chaplets on top

Calculate Weight on Chaplets

Tests under operating conditions indicate the size and type of chaplets to employ

By WARREN A. SMITH
Smith & Richardson Mfg. Co. Geneva, Ill.

TO DETERMINE the style and number of chaplets required for any given casting, the foundryman should understand something of the forces affecting a core in a mold and the strength of the different types of chaplets when surrounded by molten metal.

A core surrounded or immersed in molten metal follows the laws of buoyancy. It is buoyed up by a force equal to the amount or weight of metal displaced. Assume a sand core in the form of a 1-foot cube and therefore containing one cubic foot of sand. This cube will weigh about 100 pounds. Placed in molten iron it will sink until it has displaced 100 pounds of iron, then it will float. If pressure is applied to the upper surface until the core is entirely submerged, it will displace one cubic foot of iron weighing about 450 pounds and it will encounter resistance equal to that weight. However, as the core weighs 100 pounds, the pressure or weight required to keep it submerged will be 450—100, or 350 pounds.

Once the core is submerged, the pressure required to keep it in that position practically is the same whether it is just under the surface or considerably below the surface. Increasing the head of metal on a mold does not increase the lifting effect of the core, although it does increase the pressure on the surface of the mold.

Ratio of 100 pounds to 350 pounds, the weight of the core in relation to the pressure required to keep it submerged, or 1 to 3½, will hold for cores of any size. An (*Please turn to page* 56)

TABLE I

Ratio of Lift to Weight of Core

Material	Ratio
Aluminum	0.66
Brass	4.25
Copper	4.50
Gray Iron	3.50
Steel	3.90

TABLE II

Load Sustained by Chaplets

(Molten Cast Iron)

Stem Diameter	Double Head—Head (Square)	Double Head—Safe Load	Stem Chaplet—Head (Round)	Stem Chaplet—Safe Load—Thin Metal	Stem Chaplet—Safe Load—Thick Metal
1/2	3/8	5	.....	.....	.....
1/8	1/2	20	1/2	20	10
5/16	3/4	45	3/4	45	22
1/4	1	80	7/8	80	40
5/8	1 1/2	180	1 1/4	180	90
1/2	2	320	1 1/2	320	160
5/8	2 1/2	500	1 3/4	500	250

TABLE III

To Calculate Chaplet Area

0.7854 x 3 x 3 x 12	=	84.8 cu. in. main part of core
0.7854 x 1½ x 1½ x 3	=	5.3 cu. in neck
		90.1 total
90 x 0.06 lbs. per cu. in.	=	5.4 lbs. wt. of core
5.4 x 3.5 (ratio)	=	18.9 lbs. lift
1½ x 1½	=	2.25 sq. in. projected area of print
2.25 x 5 lbs.	=	11.2 lbs. print will safely carry
18.9–11.2	=	7.7 lbs. to be carried by chaplets
7.7 divided by 5 pounds per square inch	=	1.54 square inches of chaplet area

Clean-up Program Improves Morale

Overhaul plant facilities and equipment to anticipate return of normal business

By A. A. WICKLAND

FAR reaching changes in manufacturing methods mark the passing of a depressed business era. Sooner or later normal business conditions will return. Meanwhile, men shouldering the responsibilities of management, face the herculean task of finding ways and means to show a profit. Customers must be given first consideration even though their orders are small. Quick deliveries of quality castings are demanded.

What can be done to remedy this apparently hopeless condition? A satisfactory solution will be found if the problem including all the ramifications is analyzed thoroughly. Begin by making an earnest and comprehensive appraisal of the physical property as it exists today. Prepare a careful survey of customers' present and future requirements. Explore every possible outlet for the plant product. With this information on hand the outlook may be far from discouraging.

This survey is not complete without a check up and honest investigation to determine the true potentialities of the organization. Assuming that each member is 100 per cent loyal, mentally alert, skillful and willing, the normal reaction of reduced operation induces relaxation and slackening of the pace. This attitude hardly discernible at first, gradually assumes proportions which seriously will affect smooth and harmonious plant operation. Obviously, remedies must be found and rigidly applied to counteract this situation.

Men singly or in groups quickly respond to psychological promptings. Customers and plant organization will respond favorably to actions designed to produce these psychological results. The surest, quickest and least expensive step in this direction, is to inaugurate aggressive plant rehabilitation, thorough cleaning, painting and building repairs.

In many foundries the visitor sees an accumulation of old flasks, sand piles, dilapidated trucks and wheelbarrows, crane slings and bails, gaggers, wooden wedges, pails and shovels, and discarded equipment all in a heap. Runways and aisles are cramped and filled with obstructions. Windows are covered with a heavy crust, daylight is effectively obscured and sunlight reaches the interior only through broken window panes. In some instances the roof leaks in several places. After prolonged rain storms the molding floors are soaked or submerged.

In the semidarkness of the core room men work in congested quarters near poorly ventilated core ovens, in a smoke filled room.

A casual visitor to the cupola charging floor wonders how the charging crew perform its work from day to day without serious accident.

In the cleaning department men are forced to stand in awkward positions while chipping castings. Others struggle with a chain hoist. A worker aims an air hose at some castings and otherwise goes through the motion of sandblasting. Castings of every kind and description in wheelbarrows, trucks, and in piles are scattered over the floor and aisles with a sprinkling of rejected castings awaiting return to the cupola. An exhaust header with branch pipe connections to tumbling mills and grinders was shut down pending repairs and never restarted.

Description Somewhat Exaggerated

The foregoing description is somewhat exaggerated but cleanliness, orderliness and tolerable working conditions for the men, are not considered essential in too many foundry plants. Since every intelligent person is influenced by his immediate surroundings it follows that an aggressive and thorough clean up—paint up—with necessary repairs to buildings and machinery, including prompt disposal of obsolete equipment will start something. The program will electrify an organization and start them guessing and wondering at what is coming. Customers will learn there is something in the air. Anticipation of a change will break down sales resistance and they will be disposed more favorably to place their business, and at better prices.

Any action taken with view of favorable psychological effect, should be planned to attack the worst condition in the most spectacular fashion and—most important feature of all—the work should be initiated and carried out without consulting or divulging (*Please turn to page* 59)

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Nickel Bronze Casting Must Have Risers To Insure Soundness

We will make 2000 pounds of nickel bronze castings, the alloy being 65 per cent copper, 20 per cent nickel, 10 per cent zinc, 2½ per cent lead and 2½ per cent tin, and would appreciate information on melting and casting that metal. The castings are small, from ¼ to 1½ pounds each and without cores.

The alloy specified can best be made by melting copper and nickel first in a very hot furnace. The nickel should be added in the form of a previously made alloy 50 per cent copper, 50 per cent nickel. The furnace should be so regulated as to produce a slightly oxidizing atmosphere and should be capable of melting as rapidly as possible.

After the copper and nickel have been melted, add the zinc and tin and stir well, using a graphite stirring rod. If the atmosphere in the furnace is sufficiently on the oxidizing side, there will be no need of using charcoal; in fact charcoal will give trouble where so much nickel is present. However, the main precaution is to melt as rapidly as possible and pour as soon as the alloy is at the pouring temperature.

Feeding risers will be necessary to insure soundness of these castings; and if the risers do not shrink down and feed the casting, the casting will be porous, an indication that the metal has been improperly melted, presumably in an atmosphere of reducing gases which have been absorbed during melting.

Amount of zinc loss should be determined by experiment. It is probable that it will be necessary to add about 3 per cent of zinc to insure 2½ per cent content in the final alloy, but this may have to be increased.

The castings should be gated so that the metal runs in quietly without agitation and the casting should fill quickly. Pouring should be done carefully so that a continuous steady stream of metal is supplied, sufficient to keep the gate and sprue full. The gates should be liberal enough to insure rapid filling of each casting.

Some believe that a very small addition of magnesium to a correct nickel alloy is beneficial, but it has not been our experience where the nickel content was as low as that in your alloy.

Steel Pipe Will Buckle When Placed in Iron Casting

What effect will shrinkage have on a 1-inch steel pipe 15 feet in length in each of two legs joined by a *U*-bend at one end and open at the other end, when enclosed in a gray iron casting?

Practical experience has shown that through a certain elastic property of the metal, steel pipes enclosed in gray iron castings automatically adjust themselves to the contraction and expansion of the casting. The ends projecting from the casting increase in length, but the remainder of the pipe contracts with the casting. In the present instance the pattern for a 15-foot casting will measure 15 feet plus 1½ inches for contraction of the casting. Assuming a 4-inch print on the end for the pipes, it is apparent that allowing for a 1-inch thickness of metal beyond the loop end, the length of each pipe leg will be 15 feet 5½ inches. Under the influence of the molten metal each pipe leg will expand nearly 2 inches. Provision always is made in the print or in an opening in the end of the flask for this purpose. The casting cools and contracts to a length of 15 feet. The pipe inside does likewise. The increased length of pipe on the outside of the casting remains. Thus instead of the original 4 inches the pipes now project 6 inches.

All the foregoing is based on the assumption that the pipes are held rigidly in place in the mold and prevented from moving in any but a straight horizontal direction from end to end. Chaplets top and bottom are required at distances no greater than 2 feet apart to insure

retention of the pipes in proper position. Unless held securely in place the pipes squirm and twist while the mold is filling with iron and before they are completely submerged. In some instances these improperly secured pipes *cut through* the casting either top or bottom. In others they shift to some extent without actually cutting through. In either instance part of the total expansion is absorbed in these bends and as a result, the anticipated total will not appear in the exposed ends. Before they are placed in the mold the pipes should be cleaned and then coated lightly with red lead paint.

Relation of Combined Carbon And Total Carbon to Machinability

We have been trying to obtain information in regard to the ratio of combined carbon to total carbon in cast iron as related to the machinability of the iron. In other words, is there a definite maximum combined carbon content at which the iron is not readily machinable? Another question we would like to have answered is whether melting or superheating cast iron to a temperature of 2900 degrees Fahr. will result in the same machinability as when the iron is melted at a temperature of 2600 degrees, it being understood that both irons have the same composition.

The ratio of total to combined carbon has little direct relationship to machinability, but the percentage of combined carbon under certain conditions has a direct bearing on machinability.

An iron free from combined carbon is composed structurally of ferrite and graphite and readily is machinable. As the combined carbon is increased up to about 0.60 to 0.90 per cent, the ferrite (about 120 brinell) is replaced with pearlite (approximately 200 brinell). At about 0.60 to 0.90 per cent combined carbon the iron is composed wholly of pearlite and graphite (neglecting the presence of phosphide rich structure and manganese sulphide). These pearlitic irons, as they are called, are quite machinable, although of course not as easily machinable as irons lower in combined carbon.

A pearlitic iron low in total carbon is much tougher than a pearlitic iron of higher total carbon content, since the latter has more free graphite flakes. However, strong irons are not considered unmachinable.

There are cases where light castings may be chilled (high in combined carbon) at corners, fins, etc., although the body of the casting may be gray and machinable. These chilled spots, as they are called, are very high in combined carbon (composed largely of cementite, brinell around 600) hence very detrimental to machinability.

When the combined carbon is 1 per cent or above the iron commonly has a mottled fracture and it is quite difficult to machine. Ordinarily a superheated iron will be stronger and harder than one not so treated. There are exceptions to this, but these would require lengthy explanations.

Experiment for Desired Color in Chandelier Castings

We would like to have information on a mixture for chandelier castings, which has the same color as aluminum bronze, but provides a softer metal.

To match aluminum bronze in color with a softer alloy is a question of experiment, since there are several aluminum bronzes, no two of which are exactly the same color. One aluminum bronze known as Durigold, has approximately 5 per cent aluminum, balance copper. It has a color much the same as gold. Then there are aluminum bronzes running higher in aluminum. They gradually change in color as the aluminum content increases until they obtain a color somewhat similar to some of the yellow brasses.

To solve this problem, we would attempt to produce an alloy, containing copper and zinc and possibly 1 to 1½ per cent lead that would approximate the color, by carrying on a series of tests until we had matched the color with sufficient accuracy to be satisfactory, bearing in mind that the skin color of the rough casting in aluminum bronze or even yellow brass is not the true color of the alloy within the casting.

If this experimental alloy were to work out containing zinc, we should feel it advisable for chandelier work to add approximately 1/10 of

1 per cent aluminum to the alloy to make it a nice, clean casting as far as surface conditione were concerned.

We have suggested the use of a small amount of lead. This was particularly designed to enable the alloy to be easily machinable.

Gas Is Absorbed In Melting Aluminum

We use cast iron pots and melt aluminum in an open fire. The furnace takes about an hour to melt 50 pounds with a hot pot to start with, and we use old aluminum motor blocks. The castings are pinholed and are full of small wrinkles or pits as though the sand is wet. We use a pyrometer and pull the pot about 1100 degrees Fahr., skimming the metal well before pouring. We have tried temperatures from 1000 to 1300 degrees, but with bad results. We are making hot dies weighing from 20 to 26 pounds, and they must be smooth and sound.

Melting aluminum in iron pots is common practice. Be sure that the pot is clean when the metal is charged, and that the melting is done as rapidly as conditions will permit. Metal should not be allowed to stand in the pot longer than absolutely is necessary as it gradually dissolves iron and absorbs gases which complicate production of good castings. It is advisable to warm the pots and then apply a thing coating of whiting or French chalk in water with a little water glass added. The pots are dried thoroughly. They should be cleaned every day and the coating renewed.

Where scrap aluminum alloys are used it is common practice to flux the metal before it is poured with zinc chloride or with a mixture of cryolite and zinc chloride. Only a small amount of flux is necessary, usually a piece the size of a walnut stirred in, will flux the metal and permit skimming of the bath.

We believe that the pinholes are due to a combination of causes, including the use of an all-scrap mixture, and the absorption of gas during melting. It is advisable to use some new metal in the bath, and it naturally should be of the same composition as the scrap. While you mention that you have a pyrometer and you pull the pot about 1100 degrees Fahr., it appears that your pyrometer does not register correctly. Presumably, the scrap you are using is No. 12, and the melting point of that alloy is about 1175 degrees Fahr. The alloy usually is poured at temperatures ranging from 1250 degrees to 1350 degrees depending on the size of the casting and the section thickness. The highest temperature mentioned is for castings with very thin sections.

Exact pouring temperature for the castings you are making will have to be determined by experiments, and when you have ascertained that point, do not heat the metal in the furnace any higher than is necessary; allowing temperature loss for skimming and transportation of the metal to the pouring sand. We do not believe that a change in your sand will materially improve the condition. It is good practice to use molding sand as dry as good molding practice will permit, and to ram the mold as soft as possible without having the casting discarded by swelling due to too soft ramming. The sand should be well vented and a reasonable amount of new sand should be added from time to time to insure proper bond.

Face the aluminum molds with a good grade of molding sand which has been riddled through a fine screen. This should be backed up with coarser sand to insure free venting. We are not clear as to what you mean by hot dies so we cannot make any recommendations as to the best grade of aluminum alloy to be used. The regular No. 12 aluminum alloy containing approximately 92 per cent aluminum and 8 per cent copper is suggested.

Great Strength Not Considered Necessary

We are figuring on making some bronze top halves of connecting rod boxes for a 300 horsepower diesel engine. They will weigh about 110 pounds each. They will be babbitted so strength rather than bearing quality is needed. What composition would you recommend? Also what mixture for connecting rod brasses for the same engine?

From the information given, it would appear that the size of the half bearings in question is ample in proportion to the horsepower of the engine. Therefore, the question of the extraordinary strength does not seem necessary. We believe that such an alloy as 88 per cent copper, 10 per cent tin, 2 per cent zinc, or similar compositions would be satisfactory for the purpose of supplying the necessary compressive strength and at the same time making the operation of babbitting relatively simple.

For the connecting rod brasses, it would seem desirable to use such an alloy as 87½ per cent copper, 11 per cent tin, 1½ per cent lead, properly deoxidized with the necessary amount of phosphorus. Phosphorus preferably should be used in the form of phosphor copper, being dissolved in the copper before the addition of tin and lead. This should give an excellent account of itself in this type of service if properly made.

It is an alloy that will require more care in its manufacture than if it contained some zinc as well as the copper, tin and lead. It is quite probable that satisfactory service might be secured from an alloy similar to this with the addition of up to 2 per cent zinc. Diesel engine service is not extraordinarily hard on the bearings where they are properly manufactured and carefully fitted, because designers as a rule are liberal in their allowance.

Dip Castings To Obtain Bright Finish

We are using a bright dip composed of 2 gallons of sulphuric acid, 1½ gallons of nitric acid and 2 ounces of salt for 85-5-5-5 and other alloy castings. It seems to work well on aluminum bronze, and while the 85-5-5-5 alloy castings come out of the dip clean, they are not bright. What grade of sand usually is employed in brass foundries? We believe that we should get smoother castings than we do. We are using No. 2 Albany sand.

To obtain a bright finish, it may be advisable to dip your castings in either concentrated nitric or hydrochloric acid before using the bright dip you mention. Rinse the castings between the two dips. If concentrated nitric is employed only a few seconds' immersion will be required, while a minute or more may be needed with concentrated hydrochloric (muriatic acid). Two other bright dips that may be tried are: Sulphuric acid, 2 quarts; nitric acid, 2/3-quart; hydrochloric acid, 1/10-fluid ounce, and enough water to make one gallon; or, sulphuric acid, 1¾ quarts; nitric acid, 10 fluid ounces; hydrochloric acid, 1/10-fluid ounce, and 2 quarts of water.

The grade of sand employed in brass foundries to make castings depends on the type and size of the castings, and some foundries making a varied line may have several grades of sand. Fine grades of sand are used for light work, and where a smooth surface is desired on medium or heavy work, a facing sand composed of that fine sand is employed with a coarser backing sand. The facing sand layer, naturally, must not be thick or blows may occur. Possibly for the line of castings you are making, a No. 1 Albany may give you a smoother surface than you now obtain, but it is suggested that you obtain a small lot of that sand, and experiment with it before changing over all your heaps.

Possibly as mentioned previously, you can obtain the type of surface you desire on your castings by employing a facing of fine sand with your No. 2 as a backing sand. If you do not have some fine sand or cannot obtain it easily, take some of your new No. 2 sand and dry it. Then put it in a tumbling mill with some heavy pieces of scrap iron or whatever is available, and allow it to tumble for a while until the sand is ground to a finer state of division. After tumbling the sand is tempered to the proper condition, riddled through a comparatively fine screen, and used strictly as a facing.

The FOUNDRY Family Photograph Album

Upper Left

H. F. KLUENDER
Detroit Alloy Steel Co., Detroit

Upper Right

M. P. OHLSEN
Schwab Furnace & Mfg. Co.,
Cedar Grove, Wis.

Lower Left

T. R. LAWSON
Rennselaer Polytechnic Institute,
Troy, N. Y.

Lower Right

D. ZUEGE
Sivyer Steel Casting Co.,
Milwaukee

Men of Industry

Whose Activities Are Making Foundry History

F. A. LORENZ JR., formerly assistant vice president of the American Steel Foundries in charge of operations and general manager of both the Indiana Harbor, Ind., and the Pittsburgh works, in charge of sales and production, has been made vice president of the company. Mr. Lorenz was graduated from the University of Illinois, Urbana, Ill., in 1909, with a degree in mechanical engineering. Following graduation he became a motive power apprentice in the Chicago shops of the Chicago & North Western railroad. In 1910 and 1911 he served in various capacities in the Inland plant of the Republic Iron & Steel Co., East Chicago, Ind. He then accepted a position with the American Steel Foundries, Chicago, as manager of sales for the special steel wheel made by that company. Since that time he has served in various capacities including assistant to the fourth vice president in charge of operations and works manager of the Indiana Harbor, Ind., plant. In 1929 he was made assistant vice president in charge of operations and in 1930 he was appointed general manager of the Indiana Harbor and Pittsburgh works.

F. A. Lorenz Jr.

G. S. PARKETON and CHARLES A. GOLDEN recently have become partners in the P & G Pattern Works, Atlanta, Ga.

NORMAN J. GOULD recently was re-elected president and secretary, Gould Pumps Inc., Seneca Falls, N. Y. Other officers and directors also were re-elected.

C. B. MURRAY, Crowell & Murray, Cleveland, has been elected director of the American Institute of Mining and Metallurgical Engineers to represent the Great Lakes district.

L. R. SNELLING recently was appointed manager of planning and distribution, National Radiator Corp., Johnstown, Pa. C. L. CROUSE, vice president of the corporation, will direct all branch and divisional sales activities.

H. WASHBURN, president, Plainville, Castings Co., Plainville, Conn., discussed foundry costs at the regular meeting of the Connecticut Foundrymen's association held March 23 at the Home club, Meriden, Conn.

LAMBERT J. TILLMAN recently was elected vice president of the Wine Railway Appliance Co., Toledo, O., instead of president as recently mentioned in THE FOUNDRY. W. E. Wine continues as president.

R. E. SAVELAND, an executive of Fairbanks, Morse & Co., Beloit, Wis., since 1928, and most recently assistant to T. W. Burns, works manager, who has resigned, has been appointed general superintendent of shops.

ARTHUR L. BLAKESLEE recently was re-elected president of the Kalamazoo Stove Co., Kalamazoo, Mich. Other officers re-elected were as follows: C. M. HIGBEE and E. W. DELANO, vice presidents, and H. C. BUECHNER, secretary and treasurer.

T. W. BURNS has resigned as works manager of the main works of Fairbanks, Morse & Co., at Beloit, Wis., to join the executive staff of the A. O. Smith Corp., Milwaukee, as assistant to W. C. Heath, vice president and general manager of manufacturing.

HERMAN F. KLUENDER (see Family Album on page 33 recently was elected vice president of the Detroit Alloy Steel Co., Detroit. EDWARD A. KREILER, works manager of that company and also of the Detroit Gray Iron Foundry Co., Detroit, has been elected to the board of directors of the steel company.

C. M. SAEGER JR., physicist, United States bureau of standards, Washington, will prepare the annual exchange paper of the American Foundrymen's association to be presented before the annual meeting of the Institute of British Foundrymen, London. The subject of the paper will be "Properties of Cast Red Brass as Affected by Conditions of Casting and Impurities."

E. J. BETTENDORF has been elected to succeed his father, the late J. W. Bettendorf, as president and treasurer of the Bettendorf Co., Bettendorf, Iowa. J. H. BENDIXEN has been named chairman of the board of directors. He is also first vice president and manager of sales. Other officers are as follows: Secretary, W. E. BETTENDORF; assistant secretary, J. L. MICLOT; and assistant treasurer, A. J. BETTENDORF.

NEIL P. BAILEY, formerly connected with the mechanical engineering department of the University of North Carolina, Chapel Hill, N. C., has been appointed professor in charge of the mechanical engineering department of Iowa State college, Ames, Iowa. He will replace PROF. WARREN H. MEEKER, who will retire as head of the mechanical engineering department, but will maintain a connection with that department.

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Floor Type Mold Conveyors

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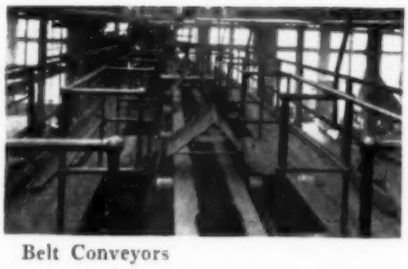
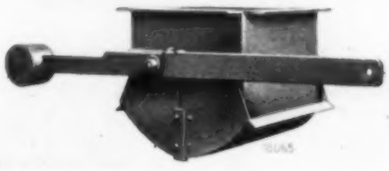
Prove "It Pays To Modernize"

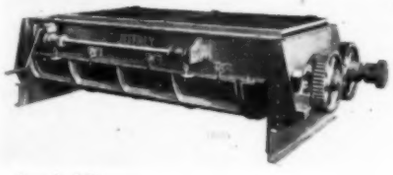


Belt Conveyors

Leak-Proof Apron Conveyors



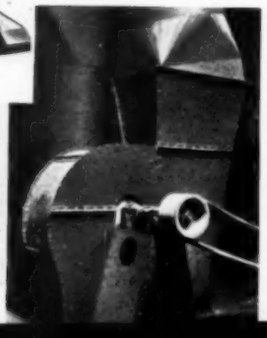
Foundry Type Valves



Sand Mixers

Aerators

Portable Conveyors



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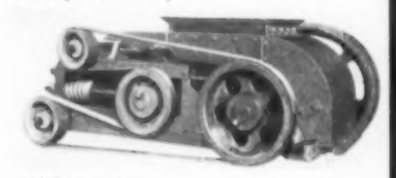
Jeffrey Foundry Engineers will help you in the modernization of your foundry operations for greater operating economy. Write them today.

Mail This Coupon—and get a copy of Catalog No. 540 in which you'll find the complete Jeffrey Service for the Foundry described and illustrated. Typical arrangements of equipment are clearly pictured by perspective drawings. Clip and mail this coupon.

Scraper Conveyors



Disintegrators

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The Jeffrey Manufacturing Company, 907-99 North Fourth St., Columbus, Ohio
Please send copy of Jeffrey Foundry Catalog No. 540

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Foundry Supply Firm Elects Officers

Frederic B. Stevens Inc., Detroit, one of the oldest and best established foundry supply firms operating in the United States and Canada recently has elected the following officers: A. E. (Mrs. Frederic B.) Stevens, chairman; W. H. Joseph Cluff, president; John M. Mayers, vice president; Lyal W. Montgomery, secretary-treasurer.

Mr. Cluff, who for many years has been prominently known in the foundry industry, started with Frederic B. Stevens in 1902. He was born at Listonwel, Ontario, but at an early age his family removed to Detroit and he was educated in the public schools of that city. His first identification with the Stevens company was in the office, but in 1914 he was made city salesman. In 1916 he was advanced to sales manager and at the time the company was incorporated in January, 1923, he became vice president. Mr. Cluff has been active in business and industrial affairs of Detroit. He was chairman of the entertainment committee in 1926 at the time of the second international foundrymen's congress which was held in Detroit, under auspices of the American Foundrymen's association. He is a member of the Detroit board of commerce.

W. H. Joseph Cluff

Mr. Mayers who was elected vice president was graduated from Princeton university in 1905. He then became connected with the Detroit Steel Casting Co., Detroit, first as order clerk, then as foundry clerk and later as assistant superintendent. Two years later he went West because of ill health, but returned to Detroit in 1908 and entered the employ of the old Michigan plant of the American Car & Foundry Co. as foundry and cost clerk. After about a year with that company he became connected with Frederic B. Stevens as a salesman. Later he had charge of a branch office and then returned to the home office in Detroit where he was engaged in the purchasing department and in sales promotion work. When the business was incorporated he was made secretary and since that time has devoted his time exclusively to sales promotion and the development of the polishing and plating supply and equipment department of the business.

New England Group Discusses Molybdenum

"Molybdenum As An Aid in the Iron Foundry" was the subject of an illustrated talk by C. M. Loeb Jr., Climax Molybdenum Co., New York, at the regular meeting of the New England Foundrymen's association held March 14 at the Engineers' club, Boston. Mr. Loeb presented a short metallurgical discussion as to the effect of molybdenum on the structure of cast iron, pointed to the physical properties obtainable with the use of the alloy, and stressed the properties directly helping the foundryman which are obtained through the use of molybdenum.

A. S. T. M. Committee Reports Progress in Work

Meetings of various committees were held during the recent Washington meeting of the American Society for Testing Materials Subcommittee on impact testing of the committee on cast iron reported that it is continuing its work on the development of a standard method for testing cast iron under repeated shock. The committee now is working on the development of a standard test method so as to secure tests from various laboratories which are comparable.

A special subcommittee has been working on the methods of making test bars, values of various bars called for in tentative specifications for gray iron castings, and recommended values for deflection in transverse tests. Considerable data have been collected and a report will be made at the June meeting of the society.

The subcommittee on cast iron culvert pipe discussed certain improvements in the existing tentative specifications for cast iron culvert pipe. The committee voted to participate in a joint A.F.A.-A.S.T.M. session on testing of cast iron to be held at the International Foundry Congress in Philadelphia in October.

The subcommittee on cast metals and alloys of the committee on copper and copper alloys, decided to review all of the nonferrous castings specifications and undertake the necessary revisions. It is planned to emphasize the physical properties of those materials and to use chemistry more as a guide, depending on the use and application of the material.

Several subcommittees of the committee on iron-chromium, iron-chromium nickel and related alloys also met. The subcommittee on classification of data reported good progress in completing the compilation of data covering chemical, physical, mechanical and fabricating properties of the alloys. The subcommittee on methods of corrosion testing reported that it is making a study of three accelerated corrosion tests. Refinements in methods are being considered.

John M. Mayers

Return To Europe

Herbert A. Stanton, European manager, Norton Co., Worcester, Mass., has returned to his London, England, office after a short visit in this country.

Michel Biscayart, Compagnie des Meules Norton, Paris; Otto Schutte, Deutsche Norton Gesellschaft, Wesseling, Germany; and William Haddock, Norton Grinding Wheel Co. Ltd., Welwyn Garden City, England, also have been visiting the home office and have now returned.

Wilbur G. Hudson has been appointed chief engineer of the Pershing Road plant of the Link-Belt Co., Chicago.

MACHINING COSTS and the CUPOLA MIX

THE most expensive casting defects are those which do not show up until practically all the machining has been completed. In such castings as engine blocks, cam shafts, pump parts, valves, piston rings, dies, brake drums and gears, machining costs many times the value of the rough casting. In such castings it is highly important to guard against hidden defects.

The cheapest insurance against serious loss through defective castings is the use of 15 to 20% of pure charcoal pig iron in the cupola mix. In one notable case it alone reduced defective cylinder blocks 68% . . . small leaks, cold shuts, mis-runs and hard iron.

For just a few cents you can protect your castings with pure charcoal pig iron and save hundreds of dollars in fruitless machining on what otherwise would result in rejected castings. Besides this worth while insurance, the charcoal pig iron addition will also greatly improve the machinability of the metal in the casting. In many cases it has actually reduced machining costs.

Use the experience of our Metallurgical Division to solve your foundry problems.

SUPERIOR CHARCOAL IRON COMPANY

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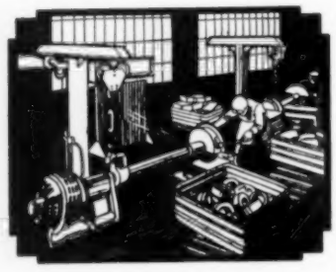
Viewing Foundry Developments

At Short Range



THIN steel plate approximately 3 x 5 feet and supported vertically on the floor serves as a safety shield for the man pouring iron into molds 5 feet in height and made up of a number of cores in stacked formation. The cores fit together closely and the danger of metal leaking, squirting or breaking through is rather remote. The shield simply represents the added precaution which anticipates and provides for the unexpected.

♦ ♦ ♦

Malleable cast iron containing over 2 per cent carbon, 1 per cent aluminum, and 1 per cent chromium may be nitrided to produce a case 1/32-inch thick in 40 hours at 975 degrees Fahr. according to a recent patent. The composition range covered is 0.90 to 2.83 per cent silicon, 0.4 per cent molybdenum, 1.5 per cent chromium, 1 to 2 per cent cent aluminum, and over 2 per cent carbon.

♦ ♦ ♦

IN A GRAY iron foundry producing 4000 duplicate castings per day formerly involving the melting of 500 tons of iron, the elimination of four small risers totaling 10 pounds on each casting, meant a total reduction of 40,000 pounds, or 20 tons in the cupola charge.

♦ ♦ ♦

Elimination of the necessity of baking molds for castings, but obtaining a mold that possesses the desired stiffness, and properties of disintegration, is said to be accomplished through the use of celluloid according to a recent patent. The celluloid is dissolved in acetone, butanol or other solvent to form a paste that has a very slight tendency to flow, but that may be handled by a paddle. The paste is added to the desired sand in the proportion of 10 to 25 per cent paste to 90 to 75 per cent sand, and the sand is used as a facing only; the remainder of the mold being made of green sand. Another method of using the celluloid is to make a thin solution, and spray it on the face of a mold made in the usual manner.

♦ ♦ ♦

A FAIR-SIZED stationary industrial compressor taking in 1000 cubic feet of air a minute and operating 12 hours a day, 300 days a year, will take in with the air between 31 and 124 pounds of dust in a year, depending on the dust concentration. While a considerable proportion of this dust is not of a gritty nature, and much of it passes through the compressor into the discharge line, enough remains to provide difficulties. This hazard may be avoided by providing the compressor intake with one of various types of air filters suitable for the purpose.

♦ ♦ ♦

With a view to eliminate steel backings, steel lugs, cast inserts, and other inclusions in brake shoes, a patented process has been developed which includes use of an iron containing 2.80 to 3.10 per cent carbon, 0.60 to 1.20 per cent silicon, up to 0.70 per cent phosphorus and 0.25 per cent sulphur, and not over 1 per cent manganese; the usual brake shoe chill mold, and a heat treatment of the casting at 1700 degrees Fahr. for 3 to 4 hours.

♦ ♦ ♦

According to a recent patent malleable cast iron may be nitrided at temperatures considerably below its thermal critical point, if from 0.15 to 5.0 per cent aluminum is added to the white iron. It is claimed that no trouble is encountered in malleableization due to the aluminum additions.

♦ ♦ ♦

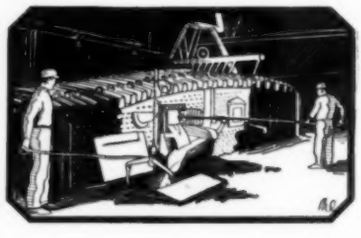
Chromium plate on cooking utensils is not affected by the chemicals found in foods and drinking water, according to a recent research carried out by Richard Schneidewind, department of engineering research, and Dr. Willis S. Peck, hospital, University of Michigan. It was found soap and washing alkalis and natural food acids, even in the heat of cooking, produce practically no effect on chromium.

♦ ♦ ♦

HIGH phosphorus iron results in the formation of steadite, a combination of iron, carbon and phosphorus. Makers of sugar mill rolls and lapping plates take advantage of that formation, for the high points of steadite on the surface prevent excessive wear and have a serrated surface which grips the sugar cane. In lapping plates, the high points of steadite also prevent excessive wear and the softer matrix between the steadite points retains the lapping compound.

♦ ♦ ♦

A specification for heat treating magnesium castings for aircraft requires heating uniformly to 770 degrees Fahr., holding for 16 hours and cooling in air. Under this treatment castings warp easily. They must be piled carefully in the furnace and



separated when cooling to permit free circulation of air. Castings then are reheated to 350 degrees Fahr., held for 16 hours and again cooled in air. Castings warping during the second heating or cooling cannot be straightened unless given another aging treatment to 400 degrees Fahr.

♦ ♦ ♦

A vacuum method for die casting aluminum bronze, whereby the metal is drawn from below the surface of the metal in the pot and is delivered to the die in a smooth, continuous flow, now is in use. Aluminum oxide formed on the surface of the metal is said to be deposited in a thin film on the walls of the die cavity, with no aluminum oxide in the interior of the casting.

ADVERTISING PAGES OMITTED

Prevent Losses with

Proper Gates and Risers

BY PAT DWYER

THE method shown in Fig. 229 is practiced in a prominent Midwest foundry for molding and pouring flanges and other castings of a somewhat similar character destined for exceedingly high pressure service. The castings are poured in a vertical instead of the usual horizontal position and are assembled for pouring in groups of 8 to 12 depending on the size. Arrangement of the runner *A*, set gate *B* and feeding head *C* is indicated in Fig. 229. The runner stick *A* is located on the gate by a dowel pin and is pulled upward through the sand after the flask section is rammed, thus providing a continuous passage for the metal from a single central sprue terminating in a pouring cup on the center and top of the assembly.

Molds Assembled in Groups

As with the cores referred to previously, each flask section forms a cope and drag in itself. The mold impression is formed in one side of the flask. The flat face on the other side serves for a cope face. After the molds are dried they are assembled on a flat bed on the floor with adjoining faces touching each other. A flask bottom plate, or in some instances a large core plate is placed against each end of the row and the entire assembly is bound together tightly by two long bolts, one on either side approximately at the center and attached to a section of steel channel beam. Miscellaneous pieces of plate are erected inside the tie rods and the space between the plates and the ends of the flasks is rammed full of sand to prevent any metal from leaking out in the event that the adjoining faces of the molds do not coincide perfectly.

It is claimed that the foregoing method produces more satisfactory castings than any other which has been tried in this foundry. Also the time and labor involved in removing the feeding heads has been reduced considerably. They are cut off so neatly with a torch that in many instances no further machining is necessary.

At this point it may be pertinent to point out that before removing the risers from 4 to 6 per cent chrome steel castings with the cutting blow pipe, the entire casting should be brought to a good black heat, about 900 degrees Fahr., because the steel is more ductile at this than at ordinary room temperature.

However, since this steel is air-hardened above 1000 degrees Fahr., care must be exercised to keep the preheating below this temperature. When the casting has been raised to the proper heat the gates and risers may be removed by the usual method without fear of cracking the casting. The cut should be made as close to the body of the casting as possible to minimize grinding, or, enough clearance may be left to allow for a subsequent machine cut.

Every steel foundryman is familiar with the fact that the great requirement in any casting is absolute soundness. Every practical steel foundryman also is aware that the attachment of feeding heads to bring about this condition of soundness is one of the unfortunate essential necessities in steel foundry practice.

In discussing this subject before a foundrymen's meeting, F. A. Melmoth pointed out that the adjective was included deliberately and advisedly. The majority of the difficulties encountered in the production of steel castings are associated directly with the natural property of high shrinkage incident on passing from the liquid to the solid state. Isolated variations of thickness from point to point in the same casting cause localized variations in the amount of liquid shrinkage and call for local treatment. From this viewpoint more than from any other, steel castings design calls for knowledge of solidifying steel peculiarities.

Absolute soundness in a piece of steel in the cast form could be obtained most simply by fixing the following conditions: 1—Solidification should commence at one point, the lowest point in the mold, and proceed upward progressively as the casting cools, a reservoir of fluid must be available to deliver to the casting the necessary amount to fill the last increment of liquid shrinkage.

Condition 1 practically fixes the necessity for a perfect taper from bottom to top of the casting. A condition, as every foundryman knows almost always absent in steel castings.

Condition 2 defines the necessity for a properly designed feeding head in which the metal will remain liquid the required length of time to meet the inevitable shrinkage demand.

Ideal Conditions Rare

Even though the ideal conditions of perfect taper or progressive variation in sectional area from bottom to top are extremely rare in steel castings, yet the problem of securing solid metal in the casting has to be solved. Progress of solidification has to be controlled in a manner to effect this purpose.

If scientific control is to be successful, it ultimately must be able to point the way to this control of solidification

Cast on Edge

FLANGES, disks and other castings of a somewhat similar character that have proved unsatisfactory when gated and poured in a horizontal position, have showed a dense and solid structure when the molds have been turned up on edge and poured in a vertical position with a suitable large riser on top. This bears out the claim that the law of gravity exerts an important influence in the efficacious distribution of feed metal and in the gradual solidification of a casting commencing at the bottom and advancing gradually to the top. For convenience in pouring a group of from 8 to 12 molds made in this manner may be assembled as a unit and poured from a single sprue. Close examination of metal in feeding heads indicates that high heads of ample volume are required on all pressure resisting castings.

by definite quantitative means. The usual method of extracting or absorbing heat from heavier local sections by the insertion of internal chills or nails, or externally by the application of surface chills, almost invariably merely represents a guess on the part of the operator. The method is an effort directed toward one main purpose, to force molten metal in the face of a mass variation handicap, from one point to another so that the metal will solidify progressively toward one or more main points in the casting.

Arrangement then can be made at this or these points to bring about the amount of feeding that will insure soundness throughout the entire mass. Proper visualizing of this progressive solidification and an appreciation of its vital influence, are primary necessities in considering the possibilities of accurate scientific control of gating and heading steel castings.

Assuming any fixed temperature of the metal, speed of solidification is dependent upon two factors: Comparative cross sectional area of the mass and the absorptive capacity for heat of the material in contact with the molten metal at the time it comes to rest.

The first factor largely controls the position of the casting. Obviously the parts of the casting in which solidification comes late should be placed in such position that their shrinkage can be fed adequately.

The second factor is much more complicated and any careful investigation will show up important anomalies in many accepted methods of gating and feeding castings. Average methods adopted in gating steel castings really is a compromise. It is not necessarily designed to exert a controlling influence on the cooling of the casting in a correct fashion after the mold is poured, but usually is just a convenient place to attach a runner from the molding viewpoint. Alternately the size, type and position of gate is forced upon the molder by the fragile, easily eroded material of which the mold has to be made.

Feed From the Bottom

During the progress of pouring the metal, those parts of the mold over which the steel passes are heated progressively in proportion to the amount of liquid metal which passes over them. Therefore this part already has satisfied a large part of its capability to extract heat from the casting after the mold is completely filled and influx of hot metal from the ladle has ceased.

Where a casting is gated at or near the botom—a favorite position since the metal enters the mold more quietly—no solidification can commence until pouring has ceased and the metal in the mold has ceased to move. If the temperature of the mold was taken at various points it would be found that the bottom over which all the steel had passed had been raised to a higher temperature at an equal distance from the steel than those parts of the mold in contact with the upper part of the casting, particularly the sand around the feeding head.

This means that the heat gradient of the mold itself also has been changed and now runs exactly in the wrong direction to bring about the best solidification conditions to insure soundness in the casting. By no means is this statement to be taken to infer that all bottom poured castings are unsound. However, it is fairly safe

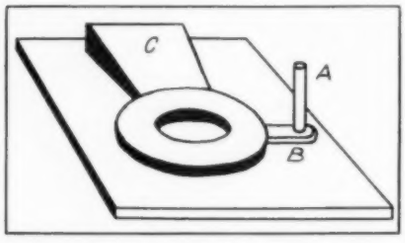


Fig. 229—Flange pattern, feeder and gate are mounted on a flat board

to claim that higher and bulkier heads are required on bottom poured castings, than on those castings that automatically feed themselves to a certain extent from high gates.

To counteract the incorrect gradient of steel temperature and mold capacity for extracting heat from the steel, heads are made very heavy and massive in section, thus insuring a fluid condition for the metal in these reservoirs over a period sufficiently long to serve their anticipated purpose.

The foregoing may be regarded as a short summary of the position of the molding side of foundry operation as a possible exact, predetermined and therefore scientific series of operations. Control of materials and their significant effect upon the product is within reach and the laboratory can be so linked up with production that the desired results can be achieved and maintained.

The operative side and the physical factors involved in the pouring, feeding and controlling of solidification call for more and more investigation. However, there is no reason why a full appreciation of the importance of temperature gradient of both mold and casting should not lead to improved practice in gating and feeding. Some modification of materials may result to permit a revision of certain methods imposed on foundrymen by the characteristics of materials at present in use.

Where a pattern of proper design and construction is ready for production the first problem for the foundry and the core room foreman in securing a satisfactory casting is that of proper heading and gating. This calls for their best judgment, as from this point on each casting becomes an individual problem and any mistakes in heading and gating will cause similar defects in each casting, in addition to whatever individual defects may develop in the course of production.

If heads are too small, shrinkage will develop; if too large, metal is wasted and a large head may crack the casting. If not properly gated, scabby, misrun or cracked castings may result. As this is so much a matter of individual judgment on the part of the foreman and as his judgment is based largely on previous experience with castings of similar design, it would seem advisable to help him by keeping a careful record of previous methods, both satisfactory and unsatisfactory, rather than force him to rely entirely on memory. With the benefit of this former experience definitely placed before him, he is in much better shape to avoid defects in castings arising from mistakes in judgment.

In addition to improper heading and gating, the record also quite properly might contain references to poorly designed patterns, warped flasks and unsuitable sand, important but often neglected factors which are responsible for defective castings and increased foundry costs.

Summary of Physical Laws

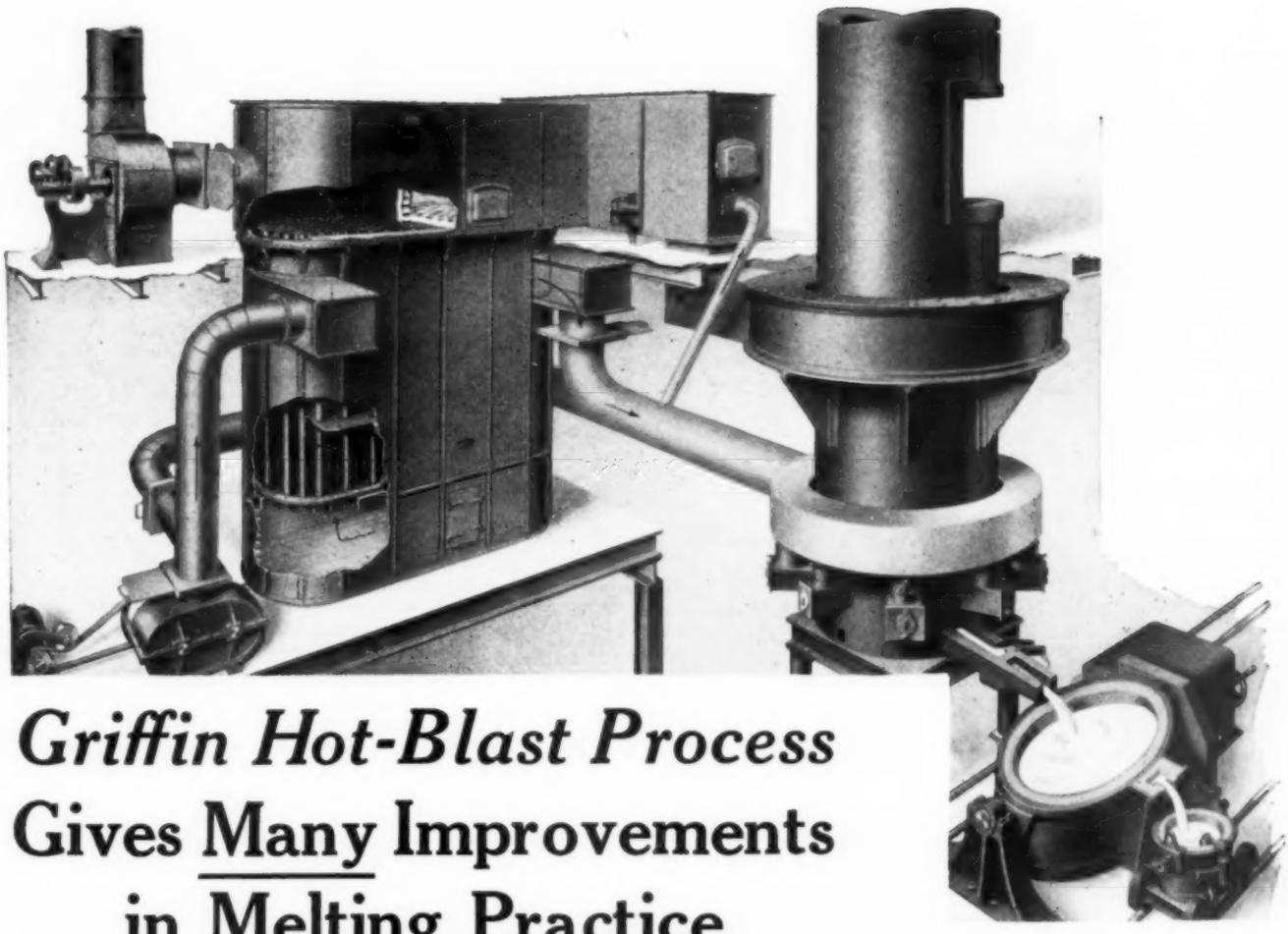
Too much emphasis cannot be placed upon the fact that the successful feeding of castings can be accomplished only through a thorough knowledge of the physical laws which govern solidification of different and adjoining masses of molten metal. This study of relative masses adjacent to each other is of fundamental importance. As with the various factors involved in the process of pouring the metal, it is found that the factors of volume, temperature and time are those which most greatly affect the final result. These physical laws have been summarized by R. B. Farquhar as follows:

1—Two equal masses of molten metal of the same temperatures and approximately the same area will solidify at the same time providing the containers or molds are of relatively the same radiating and conducting power.

2—Of two equal masses of molten metal, the one with the higher temperature will solidify after the one of lower temperature. The former will require more feeding after it has been poured, all other factors such as nature of container, chills, etc., being equal, because the one of higher temperature has a far greater drop to the solidification point, and it will require more feed after being poured at such higher temperature due to its lower specific gravity or conversely due to its greater volume per pound; hence its greater shrinkage in passing from its higher temperature to the temperature of solidification.

3—Of two equal volumes of molten metal of equal initial temperatures, the one with the greater area per

(*Concluded on page* 44)



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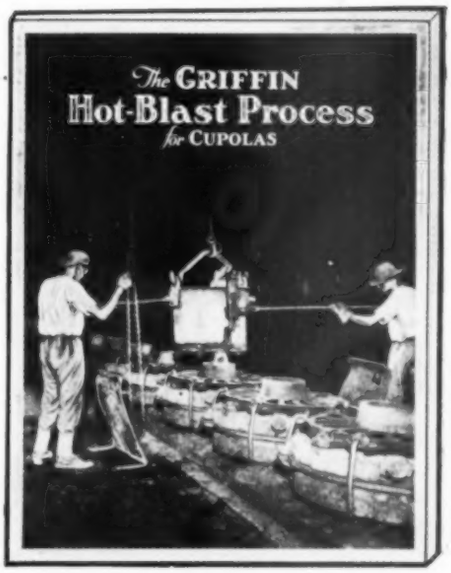

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(*Concluded from page 42*)

pound of weight will solidify first because of the greater surface exposed to the conducting and radiating effect of its container.

4—Of two castings of unequal volume, the one of smaller volume will solidify first provided the approximate areas and temperatures are the same, and the radiation through the containers are equal.

5—Of two castings of the same initial temperature, of the same area but of unequal volume, the one of greater volume may solidify before the one of lesser volume through the introduction of artificial means such as chills to accelerate the cooling of the larger.

6—The percentage of metal to feed two castings of the same volume may vary greatly if such castings are of radically different area and different section, the one with the greater area and thinner section requiring less feed after pouring but before solidification than the former.

The distinction should be borne in mind between the amount of metal required to feed a casting to get it perfectly solid throughout and the amount of riser or top discard remaining after solidification. The one may differ widely from the other, for by perfect feeding, the amount of actual riser or top discard remaining after solidification may be greatly reduced if feeding conditions are well balanced.

Referring to the first law, the introduction of chills may be used to accelerate the cooling and hasten the solidification of the one mass or the other as may be desired. In regard to the second law, striking examples of this condition have been noted particularly in pouring large castings weighing from 150,000 to 350,000 pounds.

When poured hot these castings require from 15,000 to 25,000 pounds more of feed metal after the mold is filled, and before solidification than the same castings require when poured with comparatively cool metal. The weight of the remaining riser or top discard in both cases might be the same, but the amount of feed metal required to make a solid casting will differ to a considerable extent.

This is the fifty-first of a series of articles dealing with the various types of gates and risers used in the foundry industry. The fifty-second installment will appear in an early issue.—THE EDITORS.

A recent number of "Sands, Clays and Minerals," published by Algeron Lewin Curtis, Chatteris, England, contains a number of interesting articles to the foundry field including the following: "Tungsten and Its Uses," by L. Sanderson; "Refractory Cements," by W. O. Lake; and "Sandstone Blocks for Pickling Baths," by C. Campbell.

Detroit Founders Hear Talk on Pig Iron

Detroit Foundrymen's association at its meeting March 15 at the Savoyard club heard an interesting address on pig iron by D. L. Newkirk, superintendent of blast furnaces, Ford Motor Co., Detroit. Mr. Newkirk stressed the impossibility of making iron in the blast furnace accurately to specifications by reason of the many variables encountered in raw materials. He doubted the superiority of iron made from virgin ore and believes that while sinter is the best raw material, equally if not superior quality can be obtained by proper mixture of ore and scrap. He recommends using the best scrap in the foundry cupola and remelting inferior scrap in the blast furnace. Not over 10 per cent scrap is desirable due to excessive wear on furnace linings. It is desirable to keep the slag as low as possible working the furnace with about 800 pounds of slag per ton in basic practice and from 1000 to 1200 pounds per ton on foundry iron.

Among the fifty or more present at the meeting some interesting side lights on the relation of blast furnace practice to foundry iron quality was developed. Many still are of the opinion that characteristics other than the elements present as shown by analysis may have an important bearing upon iron remelted in the cupola. The value of acid slag, obtained by adding sand to the cupola charge in some foundries was deprecated, some speakers recommending using less lime stone and avoiding the need for producing an acid condition through the use of sand.

The Ford blast furnace practice must have due regard for slag as well as iron inasmuch as the former is used for cement. Tapping into large mixers permits greater uniformity in analysis and iron is piled by ladles in racks varying by 0.25% silicon.

E. S. Renshaw, metallurgist for the Ford British plant expressed the belief of English foundrymen that better iron was obtainable from the cold blast process. Many British iron producers remelt the product from their blast furnaces and with the addition of steel and superior heat supply pig iron with as little as 2.8 per cent total carbon. This product is more homogeneous and in fact is said to be superior in composition. It is priced to foundries at a premium over ordinary iron. British metallurgists believe that the continual and increasing use of scrap steel, particularly alloy bearing classes are deleterious to foundry iron.

Fred J. Walls, Eaton-Erb Foundry Company, Vassar, Michigan, president of the association presided and Vaughan Reid, City Pattern Works, Detroit acted as chairman in introducing the speaker. A resolution of respect and a tribute to the life and service of Frederic B. Stevens, was offered by Jesse D. Stoddard. In addition to Mr. Renshaw, W. Squire, plant manager and M. Healy, foundry superintendent of the Ford English plant were guests.

Sand Is Subject At New Jersey Meeting

Discussion of molding sand by W. G. Reichert, metallurgist, Singer Mfg. Co., Elizabeth, N. J., brought out a large gathering of foundrymen at a meeting of the New Jersey Foundrymen's association at the Hotel Elton, Newark, N. J., Wednesday evening March 21.

The speaker, who is chairman of the American Foundrymen's Association's program subcommittee on sand shop operating courses and also a member of the grading committee and the committee on tests, discussed control, conservation and reclamation measures, also the use of bonding clays. He illustrated his remark with three series of lantern slides, in which he showed casting defects, grain structure and charts, bearing on the relationship between sand and the finished casting.

He emphasized proper sand control as a factor for lowering sand costs and improving castings. Mr. Reichert said ball sand difficulties could be considerably reduced by the mixture of fine sand or by the use of sand of lower clay content than that which had been used. Reclamation problems, he said, are not solved over night, but rather take time in their solution. Good distribution of clay bond is essential to good molding, and complete records of all treatments of sand prove valuable to the operator, he declared.

He presented figures showing economies which might be effected by close attention to the conservation and reclamation of sand. At one midwest foundry of modest size costs were reduced from $1 to 46 cents per ton of good castings produced. The speaker believes that the average small foundry is poorly equiped for the control and conditioning of sand, and could at relatively small expense add enough apparatus to make its installation thoroughly worth while.

Tests on sand can be made by common labor, but the interpretation of the results should be made by the general superintendent, or plant manager, and by one in full charge of all phases of sand handling. He deems it important for one man to be vested with complete supervision. Permeability, cohesiveness and green strength were discussed at length.

Holly-Stover Inc., Washington, has opened a sales office in the Straus building, Chicago, for the sale of coal and beehive foundry coke.

ADVERTISING PAGES REMOVED

Ford Casts Crankshafts

(*Concluded from page* 17)

green bond to prevent sagging or distortion of the cores in the green state.

With both units in full production the anticipated daily output will be 19,200 individual cores or 1200 stacks, sufficient to form the molds for 4800 crankshaft castings. The arrangement is extremely elastic. By varying the speed of the turntable and the number of men on each unit the output may be varied to a considerable extent to meet varying production schedules. For example before the second unit was installed a crew of 46 men, with 19 men on the turntable, turned out 800 stacks of cores daily, sufficient for 3200 crankshafts. Each stack of cores weighs 480 pounds.

Manifestly the greatest accuracy must be maintained in the thickness of the cores so that the entire stack will produce castings held to extremely narrow tolerances. Extent to which this accuracy is maintained is reflected in a report for 1912 castings which showed a loss of only 7 from the following causes: Shifted core 2; slag 1; broken cores 2; poured short 1; shrink 1. Thus in the total loss from all causes only 5 were attributable to the cores, a practically negligible loss of two tenths of 1 per cent.

Coreboxes Pass in Rotation

The empty coreboxes, cleaned and sprayed lightly with oil, pass in constant procession under the nozzle of the sandslinging machine. Then they pass under a device in which a motor driven straightedge with reciprocating action removes the surplus sand from the surface. Three operators in turn examine the surface for inequalities, repair any minor deficiencies by hand and set the core plates. The next operator pulls the corebox on rollers to the outside of the turntable and on to the table of a special device designed by the International Molding Machine Co., Chicago. The corebox is clamped to the table, rolled over and the core is lowered away from the box. As the box comes to rest the clamps are released automatically. Two attendants remove the core and place it on a shelf in an adjoining continuous oven. A third man returns the corebox to its original position and once more places it in circulation.

Cores are dried in a vertical type oven in which the elapsed time from entrance to discharge is 2 hours and 20 minutes. As the cores emerge from the oven they are removed from the plates and placed on a long, horizontal conveyor equipped with round plates, one for each core section. The hot plates from the oven are removed and hung on hooks suspended from a zigzag conveyor on which they cool, before arriving eventually at the coremaking unit. The plates are of aluminum and are extensively perforated.

On the horizontal conveyor the cores pass a battery of operators and inspectors who place copper plated steel chills in certain sections, apply a light coating of silica wash to areas brought into contact with the heaviest metal sections, and test the surface with straightedges. By an ingenious frictional arrangement each core is made to revolve horizontally as it passes under an air jet which blows away any dust or sand grains. In like manner a series of gas jets dry the silica wash before the core arrives at the end of the conveyor. Here the cores are removed and stacked on another conveyor which carries them past the assembling station.

Each stack of 16 cores is built up on a pendent type conveyor in which the carrying plate clears the floor by about 6 inches. A number on each core and a groove at one side guide the operators in setting the cores in proper sequence and position. Short pieces of cylindrical cores dropped through two openings near opposite edges of each core hold the entire stack accurately in line. A flat plate hinged to the conveyor upright member and provided with suitable openings for the runner and risers, is lowered into place on the stack and the entire assembly is bound firmly together by long bolts.

As cast, the metal in the crankshafts resembles malleable iron at the same stage, in that the metal is white, brittle and easily broken. A comparatively simple heat treatment transforms this metal into a material that is almost impossible to break. The castings are placed in a furnace and raised to a temperature of 1450 degrees Fahr., and allowed to soak for an hour. They are removed from the furnace and air cooled to a temperature of 800 degrees, then placed in a second furnace where they receive a similar treatment. Upon removal from the second furnace they are air cooled rapidly to 800 degrees, then allowed to cool slowly to atmospheric temperature.

Brinell hardness of the castings varies from 269 to 302, as compared with 200 for forged shafts before and 444 after machining and hardening. However, the hardness of the cast shaft is uniform throughout, while the forged shaft presents varying degrees of hardness from the outside to the center. It is claimed that this factor is responsible for the marked superiority of the cast shaft over the forged shaft in resistance to torsional stress and evidence of fatigue.

In a machine designed to measure fatigue, the shaft is held horizontally by the three main bearings. The center bearing is 3/32-inch out of line in relation to the two end bearings. Thus the shaft is sprung 3/32-inch out of line and while in this position is revolved at a speed of 1200 revolutions per minute. Under this severe, racking test, the cast shaft does not show any indication of fatigue or fiber stress under a period ranging from 60 to 90 minutes. Under the same conditions the forged shaft begins to disintegrate in from 20 to 30 minutes.

Obviously, this test does not constitute part of the regular production routine. It was designed and operated during the preliminary or experimental stages in the development of the cast crankshaft. With the superiority of the cast over the forged shaft established, this test now is applied only occasionally.

Apply Torsion Test

A torsion resistance test forms part of the regular routine in the finishing shop. Every shaft on the way to the assembly line is placed in a fixture where a twisting strain of 40,000 pounds is applied. It is claimed that this is approximately ten times the stress to which the shaft will be subjected at any time in service.

In this test a flange is attached by four bolts to the driving end of the shaft. This flange in turn engages one end of a short horizontal member in which the vertical pressure of a hydraulic plunger at the other end is translated into a revolving movement at the flange end.

In addition to other desirable features the cast crankshaft is considerably lighter than the forged shaft. This is due to certain features of design entirely feasible in the foundry but outside the scope of practical accomplishment in the forge. The cast shaft weighs 65 pounds rough and 56 pounds finished as compared to 82 pounds in the rough forging and 66 pounds finished.

Book Review

Reports from the Research Institute of the Gutehoffnungshuette-Konzerns, paper, 20 pages 8 x 11¾ inches, published by VDI-Verlag Gmbh., Duesseldorf, Germany, and supplied through THE FOUNDRY, Cleveland, and in Europe by the Penton Publishing Co. Ltd., London.

These reports are published quarterly, and this volume is section 2 of Part 4. It contains four papers on investigations carried on in member plants of the Gutehoffnungshuette-Konzerns or for them. One of the papers by K. Hanser relates to nonferrous centrifugal castings, and another by G. Heidehausen and L. Liebaldt discusses the reactivity speed of foundry coke. Dr. G. Wagener describes reheating in heating furnaces, and gives a simple formula for determining the mite required, and H. Schaefer presents information on investigations and experience with steel ties for use on railroads.

Melting Iron in the Air Furnace

(*Concluded from page 20*)

which are melted from the pig iron and scrap will trickle down through the bed of incandescent coke, reaching the bottom in a few seconds' time in a condition hot enough for pouring. Investigators have established the fact that metal of this kind does not seem to graphitize during solidification in the same manner as metal melted in an air furnace or in an electric furnace. Without attempting to explain the reason for this phenomenon, we can state that time and temperature probably are the controlling factors.

Duplexing, takes advantage of the low melting cost of a cupola and at the same time provides the necessary degree of superheat, or the necessary period of time in the molten condition to accomplish the refinement of the graphitizing tendency of the metal. There is an additional function of duplexing in that a reduction of the total carbon can be obtained by steel additions or by mild oxidation in the case the cupola does not bring the metal down with a low enough carbon content. There is also the advantage that preliminary analyses and corrections can be made if the cupola operates at an analysis not desired.

Duplexing in Air Furnace

Duplexing with an electric furnace is not within the scope of this paper. Therefore, I will attempt to outline only the procedure used in duplexing with an air furnace. The cupola can be placed adjacent to or some distance away from the air furnace, depending on the most convenient arrangement. The most logical arrangement is to have the cupola close enough to the air furnace so that the molten metal can be run by gravity through a long spout direct from one to the other.

It is also advantageous to have a receiver located between the cupola and the air furnace to hold an amount of metal equivalent to one cupola charge, so that the metal flowing in will mix with the metal already in the receiver and the metal flowing out will be of substantially uniform composition. The metal can also be slagged at this point and a desulphurizing agent applied. Using approximately 6 pounds of fused soda ash to the ton, the sulphur can be reduced from 0.125 to 0.090 per cent. Further desulphurization can be obtained using a greater amount of soda ash.

With such an arrangement the air furnace can be operated either for batch pouring or continuous pouring. If it is operated as a batch furnace it is usually desirable to permit the metal to remain under fire in the air furnace for approximately 2 hours. This permits ample time for preliminary analyses and the breaking of test samples before any metal is poured into castings. It also allows the metal to remain quiescent in a shallow bath so that slag and impurities may rise to the surface. Care should be taken to avoid excessive temperatures, as time and not temperature seems to produce the best results from air-furnace metal, particularly in the case of low-carbon gray iron.

If the air furnace is operated with continuous pouring the body of metal in the furnace should be approximate the amount that will be poured over a 2-hour period. This permits the metal to average 2 hours in the molten state; and while, theoretically, the incoming metal from the cupola may be adding a condition promoting the formation of coarse graphite, in actual operation no trouble is experienced from that cause.

In duplexing, the metal entering the air furnace must be high enough in carbon, silicon and manganese so that a 2-hour period of mild oxidation will bring the analysis to that ultimately desired. Despite this requirement, considerable leeway is possible in the selection of a charge for the cupola.

When producing high-test gray iron by duplexing, the charge will consist of remelt, plus a small amount of pig iron, some steel, and some purchased gray iron or malleable scrap. The operating characteristics of the cupola will, of course, determine the exact proportion to use. If desired, metal can be made entirely from steel scrap or bundled steel, making the proper analysis corrections by additions to the air furnace. Some experimentation is necessary to select the best charge to give the correct ultimate analysis, because no two cupolas and no two air furnaces operate in exactly the same manner, and raw material prices vary in different localities.

The economy of duplexing depends on the cost of materials, the size of the equipment, and the amount to be melted in a day. It is doubtful if any saving would be made over cold melting in an air furnace unless the amount of metal to be used in a day exceeds 30 tons.

Almost any type of cast iron can be made satisfactorily in an air furnace, but the air furnace is more commonly applied to the production of iron with less than 3.00 per cent carbon, because the cupola can produce this iron only with difficulty. However, for certain purposes, iron with carbon above 3 per cent is produced, and this iron can be made with great uniformity and purity. By using about 50 per cent pig and the balance remelt in the charge, sulphur can be held in the range 0.02 to 0.04 per cent and the resultant metal is close grained, with excellent physical properties.

Carbon Under 3 Per Cent

For the production of true high-test iron it is customary to keep the carbon content at a point below 3 per cent. The low carbon is necessary so that a minimum of graphite will be present in the casting. Air-furnace iron, like cupola iron, requires that, for a given metal section, the silicon content should be increased if the carbon content is lowered. As a result, most high-test iron of less than 3 per cent carbon is produced with silicon of 2 per cent or more.

High physical properties in cast iron are favored by the following: Low percentage of graphite; graphite of uniform size and distribution; graphite of a flake structure where each flake is separate from every other flake, permitting continuity of metallic matrix; absence of ferrite crystals in the microstructure; absence of cementite crystals; pearlitic or sorbitic structure in the matrix; presence of alloys of the type which add to the strength of steel.

High-test iron can be made with a carbon content as low as 2 per cent, although it is believed that none of this metal is produced commercially at the present time. Rarely is high-test iron made with less than 2.50 per cent.

The influence of carbon content on high-test iron is great, considering only those irons which have a completely pearlitic matrix. It is found

(*Concluded on page 50*)

Melting Iron

WHILE the air furnace in this country is used principally for the production of white iron castings which later are annealed into malleable iron, high grade gray iron has been produced by that process for a number of years. This article which is from a paper presented at the Chicago convention of the American Foundry men's association in June, 1933, discusses design and production methods, duplexing, control of carbon, and compositions, structures and properties obtained from air furnace irons. The author is president, Gunite Foundries Corp., Rockford, Ill.

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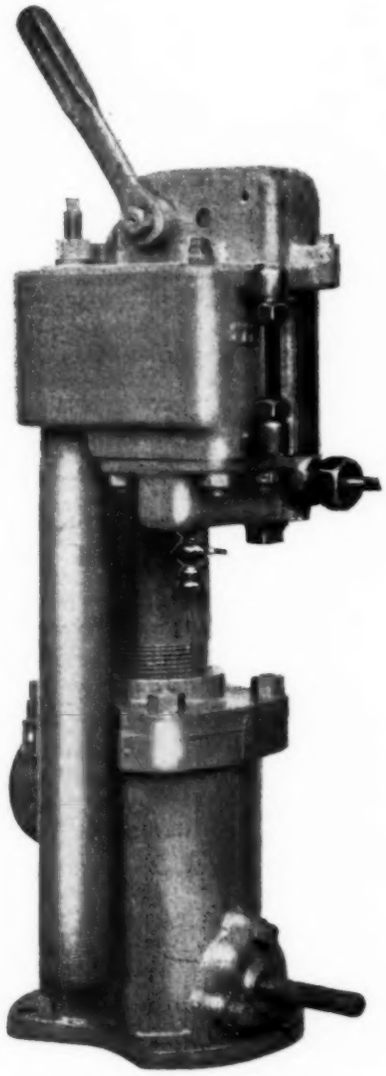

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Foreign Works: Pneulec Limited, Mafeking Rd., Smethwick, near Birmingham, England
Hartung Aktiengesellschaft, Berlin, Lichtenberg, Germany
Gibson Battle & Co., Limited, Sydney, N. S. W.

(*Concluded from page* 48)

that metal with less than 2.60 per cent carbon develops a dendritic arrangement of the graphite crystals, which becomes more pronounced as the carbon content is lowered. This results in a *woody* appearance of the fracture and an embrittlement which largely nullifies the advantages gained from a reduction in the total amount of graphite present in the castings.

To maintain a completely pearlitic structure, it is necessary to increase the silicon content of the metal as the carbon is lowered. Light-section castings will require an excessive amount of silicon, which will affect the heat-treating properties of the castings by reducing the percentage of combined carbon which can be retained in solution in austenite at temperatures above the critical.

As the carbon is lowered, the hardness of the metal has a tendency to increase. For certain purposes this is desirable, but it constitutes a handicap from the standpoint of machinability. If resistance to wear is the desired property of the metal, an investigation should be made to determine whether or not increased hardness brings about the desired result. Table III shows the analyses and physical properties of some typical air-furnace cast irons and micrographs illustrating structures are shown in Figs. 2, 3 and 4.

The use of the air furnace permits convenient use of alloys. The metal leaves the furnace hot enough to melt alloy additions quickly and permit time for thorough mixing in a ladle. Furthermore, the uniformity of analysis of air-furnace iron permits much more exact metallurgical practice than is the case with cupola metal. It must be remembered, however, that in applying alloys to air-furnace iron, only the alloying properties are of benefit because the graphitizing tendency of the metal has already been taken care of by the melting process. Characteristics of some of the more common alloys are as follows:

Molybdenum additions to air-furnace iron in amounts up to 0.50 per cent result in an increase of strength and deflection with no substantial change in hardness. Percentages in excess of 0.50 continue to increase the strength, with a corresponding increase in hardness.

Nickel additions to air-furnace iron in small amounts up to 0.50 per cent produce little change in the metal. Additions above that amount tend to increase the strength and hardness of the metal. The nickel does not produce any noticeable effect on the graphitizing tendencies.

Chromium additions are effective immediately in increasing the hardness and ultimate strength. If percentages of more than 0.50 are to be used, the metal will chill badly in thin sections and the microstructure will contain extensive deposits of undecomposed cementite. This can be avoided if the metal is produced with a higher silicon content, or if nickel is added with the chromium to provide an increase graphitizing tendency in the metal.

Manganese additions in moderate amounts have little effect on air-furnace iron, except in heavy-section castings. In this case, higher manganese tends to prevent formation of ferrite crystals during the slow cooling below the critical temperature.

The question often is asked, wherein does air-furnace iron differ from cupola iron and electric-furnace iron. This is a difficult question to answer, although there is evidence that a considerable difference exists. Some high strength irons have been made in both the cupola and electric furnace without the use of alloys. In general, however, these irons are inclined to be quite hard, which is not the case with properly made air-furnace iron.

Air-furnace iron of 50,000 pounds tensile strength can be produced with a brinell hardness of 200 or less, whereas cupola and electric-furnace iron with a tensile strength of 50,000 pounds usually has a brinell hardness of 220 or more. The reason for this difference is not readily apparent.

Much of the success of air-furnace iron can be attributed to the fact that the few foundries in this country which produce it have available skilled metallurgists and laboratory equipment to insure intelligent manufacture and uniformity.

Describes Oil Fired Crucible Furnace

R. H. Stone, of Vesuvius Crucible Co., Swissvale, Pa., spoke at the regular meeting of the Connecticut Nonferrous Foundrymen's association held March 13 at the Hotel Garde, New Haven, Conn. Mr. Stone talked on the application of a new type of oil fired furnaces in melting and brought out many advantages in the use of crucibles. David Tamor, Reading, Pratt & Cady Co., Hartford, Conn. presided.

Establishes Firm To Handle Supplies

F F. Shortsleeve who has been identified with the foundry supply business for the past 15 years and prior to that time was an active foundryman, has established his own business as foundry supply agent to handle all foundry materials with the exception of metals and fuels. Mr. Shortsleeve's firm is located in Elmira, N. Y.

Michigan State Plans Course on Melting

A group of papers featuring "Cast Iron Melting" will be presented at the second annual foundry short course to be held at East Lansing, Mich., April 19 to 21, by the Michigan State College of Agricultural and Applied Science, in co-operation with the Detroit Foundrymen's association. Information on the operation of both the cupola and the electric furnace will be presented by several speakers. The tentative program is as follows:

Thursday, April 19

11:00 a.m.—Chairman: Frederick G. Sefing, Michigan State College.
"The Development of Melting Cast Iron," by Frank G. Steinebach, managing editor, THE FOUNDRY.

2:00 p.m.—Chairman: Jesse D. Stoddard, Detroit Testing Laboratory, Detroit; R. E. Aptekar, consulting engineer, Ypsilanti, Mich.
"Slags," discussion by chairman and others.
"Cupola Design," by John Grennan, University of Michigan, Ann Arbor.

7:00 p.m.—Dinner at Michigan State College Union.
Monthly meeting of Detroit Foundrymen's association.

Friday, April 20

9:00 a.m.—Chairman: Henry M. Lane, industrial engineer, Gross Ile, Mich.
"The Air and Gases in the Cupola," by H. V. Crawford, General Electric Co., Schenectady, N. Y.

2:00 p.m.—Chairman: H. Rayner, Dodge Bros. Inc., Detroit.
"Cupola Operation," by Fred J. Walls, Eaton-Erb Foundry Co., Vassar, Mich.

7:30 p.m.—Chairman: Glenn Coley, Detroit Edison Co., Detroit.
"Electric Furnace and Duplexing," by Charles Morrison, assistant metallurgist, Saginaw Malleable Iron division, Gen. Motors Corp., Saginaw, Mich.
"Special Cast Iron Alloys," by R. D. McElwee, D. J. Ryan Foundry Co., Ecorse, Mich.

Saturday, April 21

9:00 a.m.—Chairman: Fred J. Walls.
"Cupola Control," by Carl F. Joseph, metallurgist, Saginaw Malleable Iron division, Gen. Motors Corp., Saginaw, Mich.
"What the Future Holds for the Cast Iron Industry," by H. Dietert, U. S. Radiator Corp., Detroit.

Philadelphia Group Hears Talk on Malleable

Enrique Touceda, consulting engineer, Malleable Iron Research institute, Albany, N. Y., addressed the regular meeting of the Philadelphia Foundrymen's association held at the Broadwood hotel, Philadelphia, March 14, on "The Theory, Practice, Uses and Properties of Malleable Iron." The address was illustrated by lantern slides.

C. Walter Yost, president of the association, presided.

ADVERTISING PAGES REMOVED

Pouring Temperatures of Bronze

(*Concluded from page* 25)

of this gas remains undissolved. However, if casting is carried out efficiently the ill effects exerted by this factor on the density and the mechanical properties of the bronze castings are not nearly as pronounced as those of the gases absorbed by the bronze during melting, while on the other hand it is possible to avoid that source of trouble entirely by employing suitable types of molds.

Considering the qualitative influence of gases on the properties of bronze castings within the usual range it appears, therefore, that either there is little definite knowledge on this subject, or where exact data is being given by one group of authorities most of it is being disclaimed by others. In no case has it been possible to fix any definite or generally accepted rules concerning the characteristic influence of any one of the various gases involved.

Consider Combined Effect

Different conditions obtain, where the quantitative effects of gases are being considered, that is to say, the united influence of the total amount of gases absorbed by bronzes during melting and casting. The higher the casting temperature the larger the absorption capacity of the alloys for gases. Only a small percentage of the gases absorbed at maximum temperatures is liberated in time to escape before the castings have solidified. A considerable portion of the gas liberated is caught within the solidified crust, collecting to form blowholes while the largest percentage of gas is being freed at the moment of complete solidification of the casting, forming finely divided porosities around the individual crystals.

There still is some doubt concerning the mode of formation of these porosities. It has been shown that most of them are filled with gas, but the problem still exists whether their formation is due primarily to liberation of gas within the crystals or to incipient shrinkage, that is to say, whether the liberated gas simply filters into the porosities primarily caused by shrinkage.

It is an established fact that the properties of bronzes are influenced noticeably by large quantities of absorbed gases, and that this influence asserts itself in sand cast material as well as in chilled castings. It is also futile to attempt to improve conditions by lowering the casting temperatures only, that is to say, without reducing the melting and superheating temperatures at the same time. While the solubility of gases in fused bronzes decreases with lowered temperatures, cooling down the melt to comparatively low pouring temperatures does not liberate a corresponding percentage of the gases absorbed previously. This end may only be attained by mechanical means such as stirring, or by freezing the melt completely, both of these methods hardly being applicable in practical foundry operation.

Thus, while present practical knowledge of this subject does not enable us to reduce effectively the amount of gases already absorbed and to minimize the ill effects introduced thereby, it is not so difficult to reduce gas absorption to a minimum. In melting small quantities of bronze in crucible furnaces, gases may to a large extent be excluded from the metal. Electric furnace melting precludes contamination of the bronzes entirely, so that this problem is of considerable importance only where large quantities of bronze are produced and cast from open hearth or other furnaces employing direct heating with solid, liquid or gaseous fuels.

Modern melting practice has shown that much can be accomplished by employing slightly oxidizing furnace atmospheres instead of the strongly reducing atmospheres heretofore considered the alpha and omega of melting practice. Indeed, a number of authorities have gone one step further by adding oxidizing substances to the melt. A. Portevin in the *Transactions*, Faraday society, 1925, reported, for instance, that in melting gun metal containing lead in oil-fired furnaces the air supply proved to be insufficient to render the furnace atmosphere oxidizing. He therefore added part of the lead required in form of lead oxide, casting the alloy with usual care. He found that this produced dense castings and that after several years of application this method proved to be thoroughly practical. This method has found numerous adherents among foundrymen, a development best illustrated by the fact that many of the socalled "patent mixtures" offered for improving the density of bronze castings contain manganese oxide or similar oxidizing agents.

This is the second and concluding article by Mr. Thews on the subject of pouring temperatures. The first appeared in the March issue.

THE EDITORS.

Made Representative

Eyvind W. Peterson, Rockford, Ill., has been appointed representative in the Chicago-Milwaukee district for the St. John X-Ray Service Inc., Long Island City, N. Y. At one time Mr. Peterson was associated with the Doehler Die Casting Co., Toledo, and for the past 11 years has been metallurgical engineer, Fairbanks, Morse & Co., Beloit, Wis.

Ponders Compliance Problems

(*Concluded from page* 21)

from the administrator directs all industries operating under codes to create industrial relations committees or boards for the adjustment of labor complaints and disputes. In the foundry industry, the Steel Founders' society proposed such a plan immediately after its code was approved. This had in mind the creation of a panel of labor and industry representatives. In event of complaint or dispute within a locality, the code authority was authorized to select an equal number of names from each of the two panels, representing labor and management. These men, composing a committee, were directed to choose an impartial chairman of outstanding recognition in the community and then proceed to investigate and recommend necessary action to be taken by the code authority or compliance division in settlement of the complaint or dispute. This plan has been studied by the administration.

The industrial relations committees suggested by the new order will be composed of an equal number of management and labor representatives, the former appointed by the code authority, subject to the disapproval of NRA and the latter to be chosen in such manner that all employes in the industry may be represented as fairly as possible. The administration member of each code authority will be a member of the committee, without vote but with a veto, subject to review by NRA. The committees may be on divisional, regional or local basis.

A. S. T. M. Publishes Edgar Marburg Lecture

"Crystalline Structure in Relation to Failure of Metals—Especially in Fatigue "by Herbert John Gough, the Edgar Marburg lecture for 1933 presented at the joint session of the American Society for Testing Materials and the Engineering Section of the American Association for the Advancement of Science, recently has been published in book form by the A.S.T.M. The publication may be secured from the society, 260 South Broad street, Philadelphia, for $1.00.

Die Casting Code

The code of fair competition of the die casting industry was approved by National Recovery Administrator Hugh S. Johnson on March 8 and became effective March 18

Spin Molds After Pouring

(*Concluded from page* 27)

revolutions per minute, and the duration of rotation is from 5 to 6 minutes.

The molds are made on the floor in the usual manner and then placed on one of the tables. The manner of placement of the molds is important as may be judged readily. The gate sides of the molds are arranged so that they form the inner circle as may be observed in Fig. 4, while the portions of the molds containing the castings naturally, are located on the outer rim or edge of the table. Consequently, when the table is revolving, the centrifugal force generated throws the molten metal in the mold toward the points farthest from the center of rotation.

While some may question the efficacy of such treatment by suggesting that the tendency of steel to solidify rather rapidly, it may be pointed out that extensive experimental work by the firm provides sufficient evidence of its practicability on certain types of castings. While steel begins to solidify at a comparatively high temperature, the extremely short time elapsing between finishing the pouring and commencement of rotation of the table, hardly permits more than a solid skin to form. Types of castings on which the centrifugal method is employed are those in which a side or end gate is used, and of which Fig. 5 is a typical example. That illustration shows the cope and drag molds for a gate or disk for a gate-type valve.

Fig. 6 shows a gate valve casting before the risers and gate were removed. As may be observed, it was molded on its side with heavy risers on the three flanges. The casting was gated on the parting line by a double-branch gate feeding into both sides of the flange at that point. Facing sand for the molds is composed of all new sand, 50 mesh, bonded with highly refractory clay, and bentonite. Backing sand is bonded only with bentonite. Mold faces also are sprayed with silica wash to provide additional refractoriness, and a smoother skin on the castings.

Administration Members Are Appointed

Numerous administration members to code authorities of industries related to the foundry field recently have been appointed, including the following: Chilled Car Wheel Industry, Horace B. Horton, treasurer, Chicago Bridge & Iron Works; Cast Iron Boiler and Cast Iron Radiator Industry, Steel Casting Industry, D. V. Stratton, president, Johnson Motor Co., Waukegan, Ill.; Cast Iron Soil Pipe Industry; Capt. J. D. McIntyre, United States army; Railway Brass Car and Locomotive Journal Bearings and Castings Manufacturing Industry, E. G. Vail, formerly president, Gurney Refrigerator Co., Fond du Lac, Wis.; Industry Engaged in the Smelting and Refining of Secondary Metals into Brass and Bronze Alloys in Ingot Form, Kern Gill.

Dan M. Avey, editor, THE FOUNDRY, recently was appointed administration member of the code authority of the Ladder Manufacturing Industry.

Effect of Zirconium On Cast Iron

(*Concluded from page* 23)

2.81 per cent, silicon 1.85 per cent, manganese 0.51 per cent, sulphur 0.087 per cent and phosphorus 0.02 per cent is shown in Figs. 10 to 14. Fig. 10 gives the ultimate modulus of rupture of the plain gray iron, the same iron with 1 per cent ferrosilicon and 1 per cent silicon zirconium. Fig. 11 shows the effect of ferrosilicon and silicon zirconium additions on the ultimate deflection of gray iron. The remarkable decrease in the ultimate modulus of elasticity caused by zirconium is shown graphically in Fig. 12. Fig. 13 shows the increase in drop test values with zirconium additions. Fig. 14 illustrates the effect of ferrosilicon and zirconium on the brinell hardness number.

The effect of zirconium additions is shown clearly in the microstructure of zirconium treated irons. Fig. 1 shows ordinary cast iron at 100 diameters magnification, unetched. The coarse graphite carbon is noticeable. Fig. 2 illustrates the structure of that cast iron treated with 0.70 per cent zirconium. The very fine graphite is noteworthy, and is typical of cast irons with high resistance to impact.

Fig. 3 shows the iron of Fig. 1, etched, and illustrates even more clearly the coarse structure of that iron. Fig. 4 illustrates excellently the effect on zirconium on the grain structure. The fine grain structure mentioned by Moldenke and others is characteristic of high-strength, high-impact iron.

Zirconium tends to raise strength, deflection, and drop test values, and to decrease ultimate modulus of elasticity. It has no appreciable effect on the brinell hardness number.

The fact that the test bars showing the highest values for strength, deflection, and drop test, together with low ultimate modulus of elasticity, contained no residual zirconium, leads to the conclusion that in small percentages, its chief value lies in its ability as a purifying and deoxidizing agent, and in its power to graphitize white iron.

Original data embodied in this article is used through permission of James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., and the micrographs were supplied by the Electro-Metallurgical Co., Chicago.

Washington Holds District Foundry Meeting

A conference on manufacturing methods was held at the University of Washington, Seattle, March 2, under the direction of the shop division of the mechanical engineering department. Features of the meeting included demonstrations on the main floor of the Engineering Shops building, technical sessions and an informal dinner. Registration included about 225 foundrymen from Vancouver, B. C., to Portland, Oreg., as well as 300 students.

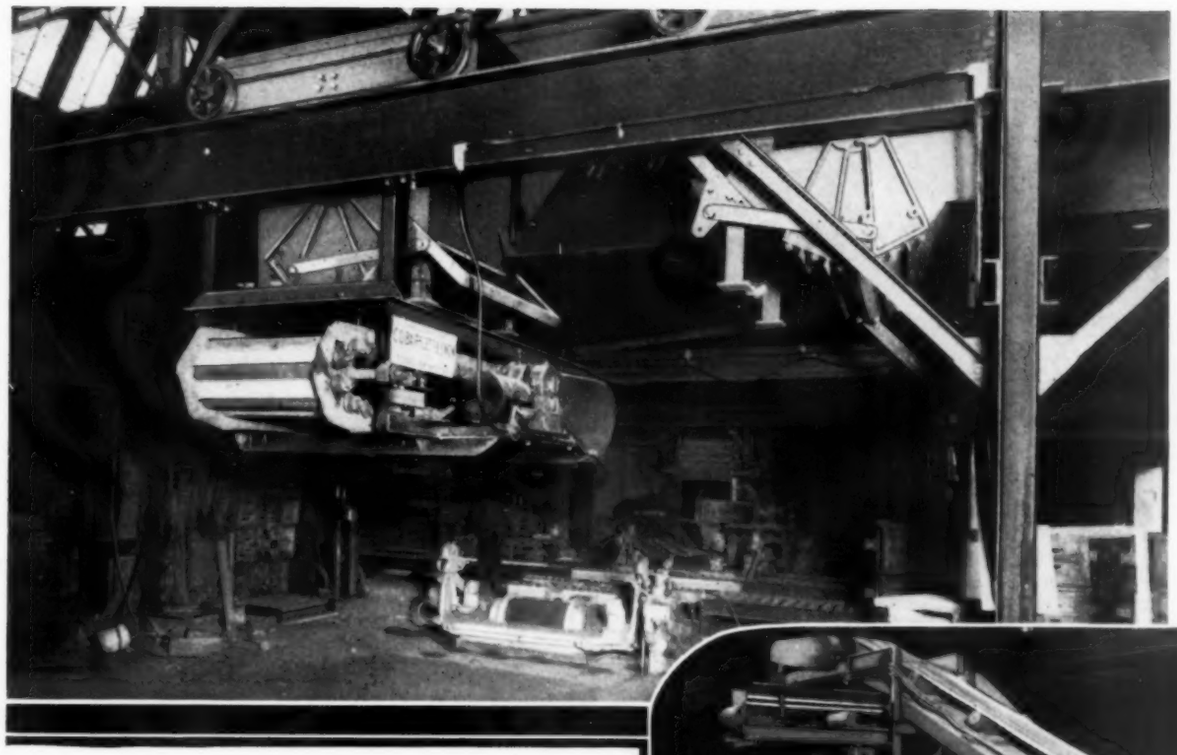
Two papers of interest to the foundry industry were presented at technical sessions. At the afternoon meeting, Alex Findlayson, metallurgist, Pacific Car & Foundry Co., Seattle, spoke on "Carcometal—A New Alloy for Steel Castings." Mr. Findlayson mentioned the growing use for cast products, citing numerous instances where castings have replaced other materials. In one example given cast shafts used on pulp stones in local mills were found to outwear alloy steel forged shafts by a considerable margin.

The second paper was presented by R. E. Brown, metallurgist, Electro Metallurgical Co., San Francisco, at the evening session and was entitled "Recent Developments in the Use of Alloys in Ferrous Castings." Other papers included the following: "Cemented Carbide Cutting Tools," by F. C. Ritner, Carboloy Co., Detroit; "Application of Hard Surfacing Alloys to Industrial Equipment," by R. J. Neill, Haynes Stellite Co., San Francisco; and "Enduro and Stainless Steels in the Pulp, Paper and Marine Industries," presented by Prof. B. T. McMinn, University of Washington.

Gilbert S. Schaller, associate professor shop engineering, was the toastmaster at the dinner held in the evening. Hugo Winkenwerder acting president of the university welcomed the visitors.

Moves Offices

The New York offices of the British Aluminum Company have been removed from 122 East 42nd street to R. C. A. building, 30 Rockefeller Plaza, New York City.



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. . . that teams gray iron with steel

RECENTLY installed, the Bartlett-Snow equipment in the Standard Stoker foundry, Erie, Pennsylvania, proves again the ability of Bartlett-Snow engineers to meet any operating condition.

Recovered from the shakeout floor, screened and tempered, the reclaimed sand is passed from the pivoted fully reversible belt into portable hoppers, which are then lifted to the overhead track and apron feeder in the molding bay. In this way the sand is kept separate... gray iron or steel can be cast on the same, or successive days... at minimum cost... and taking full advantage of the same skillfully engineered mechanical equipment.

The services of the engineers that teamed gray iron with steel, low cost and high production at Standard Stoker, are at your disposal, without obligation. Let them go through your plant and study your problems. Then, like other foundry men, you will have placed your problem in the hands of experts who prize highly their record, "Not a single disappointing installation in more than 20 years."

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Calculate Weight on Chaplets

(*Concluded from page* 28)

approximately accurate rule is that the lift of a sand core in molten iron is equal to 3½ times the weight of the core. Ratios for use with other metal are shown in Table 1. With the exception of aluminum the lift in all metals is greater than the weight of the core. More strength is required to hold the core down than to support it.

The face of an ordinary green sand mold will not support a greater weight than 5 pounds per square inch. Dry sand cores show considerable strength until they begin to disintegrate under the influence of the molten metal. Tests indicate that chaplet heads loaded up to 75 pounds per square inch do not cut into oil sand cores to any extent even where gray iron poured hot, is 1-inch thick. A heavier load may push the chaplet head into the core. Also in a thicker section of metal the core may soften and give way under the chaplet.

Perforated, ventilated and other types of so called tin chaplets, placed with the side of greatest area on the green sand, will carry about all the weight that safely may be supported on the sand surface, about 5 pounds per square inch, in a gray iron casting.

Tin shell chaplets are approximately twice as strong as other forms of tin chaplets of corresponding size, but are lacking in bearing surface. For this reason it is advisable to set these and also double head chaplets on pieces of dry sand cores or other suitable material rammed in place against the pattern.

Strength of double head and stem chaplets depends on the diameter of the stem. Loads safely sustained by chaplets in molten cast iron are shown in Table II. Figures in this table are based on actual experiment and of course are approximate since pouring temperatures and other conditions may vary. A fair margin has been allowed for safety. Metal thickness less than twice the thickness of the stem is listed as *thin*, while a thickness up to four times the diameter of the stem is listed in the table as *thick*.

A general rule of estimating casting requirements is to first get the weight of that part of the core nearly surrounded by metal. A sample may be weighed in a scale, or the weight may be estimated at the rate of 100 pounds per cubic foot or 0.06-pound per cubic inch. The lift then is found by multiplying the resultant figure by the ratio shown in Table I. Any prints or points where the core cuts through on top or bottom may be figured as carrying 5 pounds per square inch. The remainder of the lifting force exerted against the core will have to be borne by the chaplets. Where one half of a relatively long core is well anchored in a core print, about half the load will have to be carried by chaplets placed near the unsupported end.

Judgment and experience are required in the selection of chaplets. Usually several light chaplets are preferable to a few heavy chaplets. Tin chaplets which do not require to be supported on ram-up cores find favor over any others if an excessive number is not needed. Method of calculating the chaplet area on the casting shown in Fig. 1 is shown in Table III.

Referring to Fig. 1, it will be seen that a chaplet will be required underneath the core to carry about half the weight of the core, or say 3 pounds. The area of the chaplet should be about half a square inch. Various types of chaplets are available.

On the cope side about 8 pounds of lift has to be spread over 1½ square inches of chaplet area. Two ⅞-inch square ventilated chaplets would serve if placed near the unsupported end of the core. Alternatively, two 1-inch square perforated chaplets, or radiator chaplets of the required head area might be used.

Another type of casting, a centrifugal pump base cored out to serve as a reservoir is shown in Fig. 2. The inlet and outlet furnish no support for the core and may be disregarded in chaplet calculation. The mold is green sand with a dry sand core on the inside.

This core contains 1 x 1½ x 2½ or 3¾ cubic feet of sand and weighs about 375 pounds. The core lift in gray iron would be 375 x 3½ or 1312 pounds. According to the data in Table II five double head chaplets with ¼-inch stems each capable of carrying 80 pounds would support the core if they were placed on ram-up cores, each core presenting at least 16 square inches of surface.

Double head chaplets might be used on the cope, but the lift is so great that it is safer to use stem chaplets anchored against a bar on the outside. In this instance the metal would fall into the thin classification as shown in Table II. Therefore four ½-inch stem chaplets, each capable of supporting a load of 320 pounds would answer the purpose.

In many instances where danger exists of the core moving to one side or the other, light double head or perforated chaplets are suspended on wires, or in some instances tightly wedged between the main core and ram-up cores in the face of the mold.

Presents Tables

AS A PRELIMINARY to formulating the simplified rules for estimating the size, shape and number of chaplets required for holding any given core in place, the author devised a rig for testing chaplets on green sand without heat, also chaplets heated in a heat treating furnace and then verified his results by observing the action of chaplets in molten iron. The accumulated mass of data, observations, experiments and calculations has been boiled down and crystallized in the accompanying article.

Pittsburgh Group Discusses Management

"Management's Job Under the New Deal" was the subject of an interesting paper and discussion conducted by Edwin S. Carman, president, Edwin S. Carman Inc., foundry consultants, Cleveland, at the March meeting of the Pittsburgh Foundrymen's association, Ft. Pitt hotel, Pittsburgh, March 19. An enthusiastic gathering, somewhat larger than usual, turned out for the dinner and the evening's address. About 75 members of the association and visitors attended.

Mr. Carman in the course of his address changed the title of his paper to show that management's job under the new deal after all is based on a responsibility of managament under a square deal. He also discussed the matter of conducting foundry business without the aid of liberal bank credit and pointed out how this fact might correct an abuse of some years standing in the condition of long delinquent accounts. One of his recommendations to foundrymen present was that they adopt a system of requiring payment from their customer on the tenth, twentieth and thirtieth of each month.

Mr. Carman showed with lantern slides, several important aspects of overhead and waste costs in foundries as well as making the recommendation that certain corrections in power, materials and labor wastes be corrected. In conclusion, several interesting slides were shown of some recent foundry installations, both complete units and several mechanized features. Throughout the discussion he stressed on the problems of the smaller foundry.

W. I. Brockson has become associated with the Commercial Advertising Agency, 440 South Dearborn street, Chicago. Mr. Brockson previously was advertising manager of the Steel Sales Corp. He is a past president of the Engineering Advertisers' association and a frequent contributor to trade magazines on the subject of advertising and selling.

ADVERTISING PAGES REMOVED

British Institute of Metals Meets in London

The twenty-sixth annual general meeting of the British Institute of Metals was held in London on March 7 and 8. Dr. H. Moore, director of the British Nonferrous Metals Research association, succeeded Sir Henry Fowler as president. The following vice presidents were elected: W. R. Barclay, London; Prof. C. H. Desch, Teddington; A. G. C. Gwyer, Warrington; Prof. D. Hanson Birmingham; H. C. Lancaster, London; E. L. Morcom, Birmingham.

Thirteen papers were presented at the meeting. The first was by Dr. G. A. Hankins and C. W. Aldous, of the National Physical Laboratory, Teddington, on "Minimum Dimensions of Test Samples for Brinell and Diamond Pyramid Hardness Tests." It is concluded that a width of test-specimen of 4½ times the diameter of the impression is satisfactory for accurate brinell tests on all the materials examined. In regard to the thickness of samples for brinell tests, the limiting value of the ratio of thickness of test sample to depth of impression for accurate results appears to be a characteristic of the test material; a value of the ratio of 6 is required for mild steel, about 15 for copper, and more than 20 for spring steel.

Prof. A. Portevin and Dr. P. Bastien, of the Ecole Centrale des Arts et Manufactures, Paris, presented a contribution entitled: "Castability of Ternary Alloys." The authors first defined the castability of a molten metal or alloy as being its ability to fill a mold completely. This property can be determined by ascertaining the length of a spiral cast-iron mold filled by the metal under predetermined casting conditions. The castability of a pure metal is a linear function of the difference between the pouring temperature *T* and the melting point *F*, the slopes of the castability (T-F) curves vary with the viscosity of the metal. The castability of binary alloys varies with the solidification range and with the mode of crystallization. Maximum castability occurs with the eutectic composition, and minimum at the limit of solid solubility. The castability of ternary alloys varies inversely with the primary solidification range, and in cases where this is nil, it varies with the secondary solidification range, reaching a minimum at compositions corresponding with the transition from two-phase to three-phase fields. These laws were illustrated with reference to several binary antimony alloys and to ternary alloys of lead, tin, and bismuth, and of iron, carbon and phosporus. Finally, the value of this method of testing alloys for practical foundry work was discussed, and it was shown to be useful in determining the composition of eutectics and of saturated solid solutions in metal systems.

Prof. D. Hansan and Dr. E. G. West, University of Birmingham, gave a paper on "Constitution of Copper-Iron-Silicon Alloys." Alloys examined contained up to 8 per cent iron and 8 per cent silicon. The solubility of iron in copper is decreased by the presence of silicon. Over the greater portion of the range of compositions examined, iron exists in the alloys as such, containing only a small amount of silicon and copper in solution; its solubility in the solid state decreases rapidly with fall of temperature and becomes very small below 700 degrees Cent. With certain ranges of composition, iron and silicon combine to form another constituent, probably FeSi, which forms a series of alloys with the *a* solid solution. FeSi also appears to form systems of alloys with the alpha, beta, gamma, delta, and epsilon constituents of the copper-silicon series. The shape of the liquidus and solidus curves has been determined and the changes occurring in the system during the process of cooling from the liquid state have been indicated. The constitution of the alloys suggests the possibility of modifying their mechanical properties by heat-treatment.

Feature Cast Iron At Quad City Meeting

Hyman Bornstein, Deere & Co., Moline, Ill., was the principal speaker at the joint meeting of the Quad-City Foundrymen's association and the Quad-City chapter of the American Society of Mechanical Engineers held March 19 at the Blackhawk hotel, Davenport, Iowa. Mr. Bornstein, who served as chairman of the advisory committee on the symposium of cast iron, discussed in detail the important factors contained in that work, which recently has been published in book form by the A.F.A. and the A.S.T.M..

Several other topics were discussed at the meeting by a number of speakers. M. J. Gregory, Caterpillar Tractor Co., Peoria, Ill., talked on "Special Castings." E. K. Smith, Electro Metallurgical Co., Chicago, spoke on "Changes in Castings." Garnet Philips, Frank Foundries Corp., Moline, Ill., discussed "Melting Operations."

The next meeting of the group will be held in Moline on April 16, and will be devoted to a discussion of "Shop Equipment and Job Standardization." The nominating committee, recently appointed by President Harry F. Henninger, will report on officers for the coming year at that meeting.

Clean-up Program Improves Morale

(*Concluded from page 29*)

others the plans for improvements.

In inaugurating a policy designed to increase sales and reduce operating expenses, wholehearted consideration must be given to the proper functioning of the mechanical equipment, beginning with raw materials handling and storage facilities, interdepartmental transportation, material weighing and charging, melting equipment, etc. A study along that line undoubtedly will disclose that much can be done to insure a higher quality of metal at lower cost.

Trend of the times shows an ever growing demand for better castings. High grade castings can not be made, economically, without proper melting equipment. Comparatively inexpensive sand conditioning systems, now are available which permit continuous molding and pouring. In this connection, the use of permanent molds for certain kinds of castings is worthy of serious consideration and investigation.

Core making cost is fractional compared with other items of expense. However, the core department offers excellent opportunities for the introduction of improvements which will effect a substantial reduction in production costs. Continuous core ovens are applicable to most foundries but owing to the capital investment, are found only in the larger plants. The old type of box oven has its place for mold and core drying, especially, since modern improvements remove the moisture and accelerate heat transmission, thereby promoting faster drying without danger of burning; with greater and faster output at lower fuel costs.

A study of the present cleaning room may disclose that a general clean up—paint up—and repairs to building and equipment, will work wonders. Valuable working space may be added by rearranging the equipment. So far as possible all operations in that department should be performed progressively, without crowding and congestion. Adequate daylight and ventilation will contribute greatly in obtaining more and better work.

While all departments are indispensable links, the fact remains that the molding floor is the heart of the foundry, and constitutes the foundation upon which a successful enterprise is built. For business reasons alone, that department should be a model and reflect enterprising management.

Tessmer Machine & Tool Co., manufacturers of foundry equipment, recently moved to 3337 St. Joseph street, at Gratiot avenue, Detroit.

Some where a voice is calling!

The Adventures of Bill

BY PAT DWYER

ON ONE of the radio programs the other night, a lad with a nice strong baritone voice sang that beautiful and sentimental old song, *When You and I Were Young.* I have heard this song attempted millions—well perhaps not millions of times—manifestly that is an impossibility—let us say many hundreds of times. Only rarely have I heard it sung in a perfectly satisfactory manner. The proper effect is lost when it is mumbled by a crooner, screeched by a thin reedy tenor or huffed and puffed by a basso profundo, who rumbles down the bass clef as musically as an artillery battery in action.

On this occasion the rendition was so perfect that I felt it was worthy of comment.

"Well," said Bill, "I'll tell you. It is a good old song and I am rather partial to the melody myself, but the words are kind of goofy."

"Goofy!" I exclaimed in astonishment. "Here's a song, a universal favorite for over 50 years, a tender, sentimental reference to conjugal felicity, a charming tribute by an old man to the wife of his youth. You characterize the words as goofy! Why the cynical attitude? Something you ate, or a few poison tipped words from Mrs. Bill?"

"Thank you kindly, sir, she said for inquiring, but the answer is *no* to all your impudent questions. Digestion is fair, Mrs. Bill is fairer, and the lights are burning bright, sir! Which is just another way of saying that my opinion of the song is based on a calm analysis uninfluenced either by sympathy or malice, or by the enthusiastic opinions of others. If you kindly will hop down from your prancing steed, lay aside the lance and spear and bend one eye and perhaps one of your long ears in this direction, I shall show you what our legal friends usually designate exhibits *a, b, c, d,* etc. I do not expect either to convince or convert you, but I think I can knock at least one or two props from under your smug belief that I am all wet.

"Take the first two lines, 'I wandered today to the hill, Maggie, to watch the scene below.' From the number of *to's* in that sentence a casual reader might be justified in the inference that the old boy was on a toot. This inference further is strengthened by the statement that he wandered to the hill, instead of walking or running in a bold, straightforward manner to the top. He merely wandered or rambled in an aimless, listless manner 'to watch the scene below.' He advances no earthly reason to explain why the scene below was improved by watching it from the top of the hill instead of the bottom, except that he liked to look at 'the creek and the creaking old mill, Maggie; as we used to long ago.'

"To follow the music in this line, and in fact wherever the name occurs in the song, the lady is addressed as Ma-gee with the accent on the second syllable and with the *g* hard as in gate, goose, goat or gumboil. A person's name is an intimate possession and no one likes to have his or her name manhandled or mispronounced. The singer is forced to hop another hurdle in the second half of the line to bring it out even with the musical score. Long ago becomes long ah-a-go.

Try a hot cha number p'fesser

"Our hero arrived at the top of the hill is grieved to find that 'The green grove is gone from the hill Magee, where first the da-a-asies sprung. The creaking old mill is still Magee since you and I were young.'

"Speaking off hand, with charity for all and malice toward none, it would appear to me that a man gifted with even less than normal eyesight could observe these phenomena without going to the bother of climbing the hill. Also, although laying no claim to expert horticultural knowledge, I think he is slightly in error in stating that the first da-a-asies sprung in the gloomy recesses of a grove on the hill top. In my young daisy gathering days the blossoms persisted in appearing first in the sheltered valleys and great open spaces.

"In the second verse we are introduced to 'a city so silent and lone Magee where the young and the gay and the best, in polished white mansions of stone Magee have each at last found a rest.' This sentiment of course is in accordance with a somewhat popular belief that all the good die young. As with many other popular beliefs, a few moments calm observation and reflection will shoot it full of holes. For every hoary headed pirate or lantern jawed virago in any given community you can fine a dozen honest, upright old patriarchs and mothers in Israel. So far as my observation extends, a man's moral character exerts precisely the same degree of influence as the length of his nose on the anticipated span of life. That degree is precisely zero. So what?

" 'There's where the birds built their nests Magee and joined in the songs that were sung, for we were as gay as they Magee when you and I were young.'

"No person reasonably can find any fault with the feathered songsters building their nests and carolling in and around the polished white mansions of stone, but certainly that is the last place in the world a group of young merry makers would select for holding a party or a concert. Young people afflicted with the singing itch

(*Concluded on page* 62)

Pare Grinding Costs

by Doubling wheel-speeds

TODAY, production costs must be pared to a minimum. A saving made in any department is a saving for the whole plant. In the grinding shop, for example, savings as high as 50% may be effected through the adoption of high speed snagging wheels, for grinding costs may be reduced directly as wheel speeds are increased.

Snagging wheels bonded with Bakelite Resinoids may be operated safely and efficiently at speeds up to 9,000 S. F. P. M. Even at these advanced speeds, these wheels operate coolly, without gumming or sticking, give off no offensive odors, last longer, and cut deeply with a minimum of effort on the part of the operator.

The adoption of high speed snagging equipment and wheels bonded with Bakelite Resinoids will save money for your plant. Consult the supplier of your grinding equipment, who possesses many facts on the economies of high speed grinding, or ask us for a list of the many manufacturers of these wheels.*

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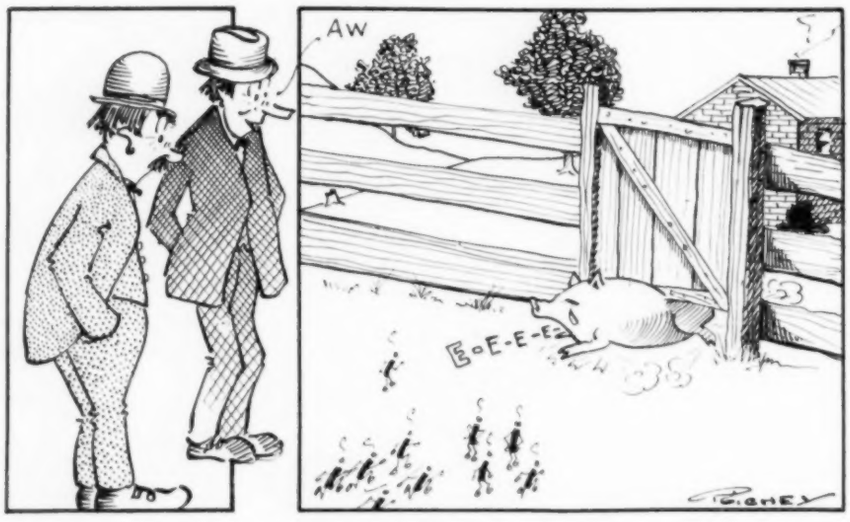
THE MATERIAL OF A THOUSAND USES

(*Concluded from page* 60)

have been known to break out in the most unexpected places. If the hero merely claimed that his party sang or even whistled while passing the cemetery on a dark night, one might accept the statement, but going inside to hobnob and yodel with the birdies is pitching the key a trifle too high.

"'And now we are aged and gray
Magee, the path of life is nearly done
Let us sing of the days that are gone
Magee, when you a-and I way-er young.'

"See what I mean by the singing



From *The Three Little Pigs.* **By special permission of the copyright owners**

itch? It is practically incurable. Here is an old lad by his own admission almost to the end of the road, and yet he wants to sing! Not only wants to sing, himself, but insists on dragging the ever faithful and patient Magee in with him. Her proper name is Margaret to be used on all formal occasions. To a few intimates of her youth she is known as Maggie. Every time she hears 'Ma-gee' she jumps as when the dentist touches a nerve. For a period of 50 years—more or less—she has endured this form of petty martyrdom in silence—"

"Who's goofy now?" I interrupted. "You may be right or you may be wrong in some of your conclusions, but when you talk about a woman suffering martyrdom in silence you—er—forfeit the confidence of the jury. Your case is gone without any further argument. The only reason a woman endures martyrdom of any kind is because she derives such a peculiar and exquisite form of pleasure in squawking about it. Silent, eh? So is a pig under a gate!"

"Tut, tut!" Bill waved an admonitory finger in my general direction. "I see no reason for introducing such a vulgar comparison. 'Tis true I voiced some mild measure of protest over the wording of the song. If you had not crept under the gate prematurely, I was going to point out to you that the author redeemed himself handsomely in the last line of the song, 'But to me you're as fair as you were Maggie, when you and I were young.'

"Gross flattery, of course, but the sentiment shows that the old boy's heart was in the right place, and despite a life-long acquaintance, the party of the second part probably believed him. In this respect some of my most trustworthy spies inform me that women are almost as susceptible and gullible as men.

"However, your casual reference to a pig under a gate reminds me of an inquiry I had recently from a foundryman who wrote that he was thinking of casting an 85-5-5-5 sleeve on a cast iron roll 13 inches diameter, 52 inches in length and ¾-inch thick with a steel shaft through the center. He wondered if the sleeve might crack during construction. He also would appreciate suggestions on gates, risers and general molding features.

"From the description I was not quite clear whether the brass sleeve was ¾-inch in thickness, or, if the cast iron roll was to be ¾-inch thick in the wall. However, I assumed that the brass was to be ¾-inch thick and that the roll was approximately 2 inches thick to conform to his further statement that roll and shaft weigh approximately 1500 pounds.

"In this particular instance the shaft presents the only hazardous or doubtful feature in the success of the program. The molten brass flowing around the roll body will raise the temperature of the iron and cause it to expand. Iron and brass then will cool in harmony and obviate any danger of cracking in the brass shell. Since the brass does not come into direct contact with the shaft, that member will not expand to the same extent and possibly *may* set up a complication. However, it is quite possible that the iron shell will *creep* on the shaft a sufficient distance to compensate for the difference in expansion and contraction.

"If the iron roll has openings in the ends, he can build a charcoal fire on the inside, or use a long flame torch to heat the shaft. In fact this would be the better way to heat both shaft and roll preparatory to pouring the brass. If the ends of the roll are closed the roll may be raised to a temperature of between 200 and 300 degrees Fahr., preferably in a wood fire. The ideal condition would be a red heat, but at this temperature a film of oxide forms on the surface and the brass would not lie quietly against the iron. Needless to say the surface of the iron roll must be perfectly clean. This is accomplished by pickling, sandblasting or grinding. The least film of oxide will cause the brass to boil violently in the vicinity and result in a honeycombed casting.

"With a good substantial iron flask and other corresponding rigging, I should favor casting the job on end in a dry sand mold through a ring of small pop gates. In the absence of this kind of equipment, fairly satisfactory results may be secured in a horizontal skin dried mold, or, at a pinch and by using the greatest care, in a green sand mold. In the horizontal mold a runner almost the entire length of the mold is formed in the drag joint parallel with the mold cavity. This is fed from a single sprue rising from the center. A number of shallow gates about 2 inches wide and spaced about 3 inches apart conduct the metal into the mold.

"The sleeve will weigh about 450 pounds and about 600 pounds will be required in the ladle or crucible to pour it. The excess metal will flow through three risers, one at the center and one near each end. Flowing the extra metal through the risers merely is a precautionary measure.

"Provided the form of construction would be suitable, all the trouble and risk might be avoided by pouring the sleeve as a unit in the ordinary manner either on end or horizontally. Roll and sleeve then are machined to a tight fit and the sleeve forced into position. Additional and in many instances sufficient security is assured by drilling a number of holes through both sleeves and roll. Studs are screwed into these holes and cut off flush with the surface. The entire face then is machined. Alternately the entire roll might be cast in brass with a steel shaft in the center as in the present instance.

"In a third and probably the best method of all three, the brass sleeve is cast in the usual manner, machined on the inside for a shrink fit at the center and both ends, then raised to a red heat and while in the expanded condition dropped into place over the cast iron roll."

ADVERTISING PAGES REMOVED

European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Sand Tests

Properties of Foundry Sands at Different Temperatures, by Prof. Ing. A. Mitinsky and Ing. J. Venglar, paper presented at the recent foundry congress in Prague.

A series of pressure tests, shearing tests and permeability tests on sand were carried out. Test pieces were made of different kinds of sand of varying moisture, and they were dried 2 hours at various temperatures up to 900 degrees Cent. Strength of the sand depends to a large extent on moisture and on temperature of drying, and shows local maxima and minima. Strength and permeability of the test pieces dried at different temperatures have no relation to the values obtained by testing undried sands. It also was found that sands having bad or unsatisfactory properties in the cold state may have good properties when heated, and vice versa. To judge the qualities of the sand, it is inadvisable to make tests in the cold state.

Steel in the Cupola

Melting Steel in the Cupola. (La Fusion de l'Acier au Cubilot) by G. d'Ardigny. *Le Revue de Fonderie Moderne*, Paris, Aug. 10, 1933.

Cast irons with a carbon content well below 3 per cent can be obtained in the cupola. Good castings can be made with iron containing about 2.6 per cent carbon, and such iron can be made by using charges containing a high proportion of steel scrap.

Steel itself has too high a melting point to be readily melted in the cupola, but it gradually becomes case-hardened in contact with the coke, and as carbon is absorbed, the melting point decreases and the steel melts gradually from the surface toward the center. This is termed primary carburization.

This process is facilitated by a high temperature in the melting zone, which can be obtained best by increasing the pressure of the wind up to a certain point, and this can be done without unduly increasing the coke consumption. By taking certain precautions, it is always possible to limit this primary carburization in the cupola to a maximum of 2 per cent carbon.

The case-hardened steel which melts and flows on the incandescent coke is then submitted to secondary carburization, which depends on the initial composition of the steel, the temperature, the time during which it is in contact with the incandescent coke, etc. It can then attain 3.2 per cent carbon, and it is on this secondary carburization that it is more than necessary to act.

If there is no forehearth to the cupola, the carburization can be limited by frequent teeming of the furnace, but a separate forehearth is the best method, especially if it is heated. It is also recommended to reduce the height of the tuyeres above the hearth. By such methods it is possible not to exceed 0.4 to 0.5 per cent carbon in the secondary carburization over and above the carbon absorbed in the primary carburization. Apart from the necessity of limiting the secondary carburization, it is also advisable to act on the primary carburization, because there is thus less risk of burning the metal.

Turning to actual practice, it is recommended not to use rusty steel scrap in the charges. As steel tends to absorb more sulphur than ordinary iron charges, steel containing silicon is recommended; for instance, automobile and railway springs are particularly good material. Notwithstanding all the precautions that can be taken, one can obtain a 2.6 per cent carbon iron having a low castability and sometimes containing metallic inclusions, particularly with charges containing from 60 to 70 per cent steel. It is best to use material already containing from 0.8 to 1 per cent carbon, because the more carbon contained originally, the less the tendency to carburization.

Another recommended practice is to obtain an iron with about 1.5 per cent silicon, 2 to 2.2 per cent carbon and 1 per cent manganese, treat this iron with soda and remelt it with the proper proportion of scrap, wasters, etc., to obtain the required carbon content. The cost of this method is higher, but a much better product is obtained.

Size of Tuyeres

Study of Cupolas with Small Tuyeres Etude Sur les Cubilots Munis de Petites Tuyeres, by Gabriel Itam. *La Revue de Fonderie Moderne*, Paris, Sept. 10, 1933.

For a long time the author was convinced that cupolas should be fitted with tuyeres of very large dimensions. Observation of five cases in which cupolas gave unsatisfactory results with large tuyeres brought the conclusion that smaller tuyeres should be used. In the first case tuyeres of large dimensions had to be changed. The case was urgent, and only 4-inch tubing was available. This was used to replace the original tuyeres, and proved entirely satisfactory. In the four other cases, relatively small tuyeres were used deliberately, and gave satisfactory results.

In a cupola, the gases can pass only in the empty spaces existing between the pieces of coke in the melting zone, and these gases will pass all the more quickly as the pressure inside the cupola is greater. To increase the section of the tuyeres with a view to providing for their clotting up during the melting only tends to increase the tendency to bridging, since the air passing through large apertures has a reduced speed and runs along the walls of the cupola and cools them, instead of going toward the center as required.

Incidentally, the author expresses the opinion that it is a mistake to endeavor to obtain too economical an operation by trying to reduce the consumption of coke, or the quality of the coke. In the long run, the proper expenditure on coke proves to be the best way of obtaining an economical operation.

Obituary

G. F. ROYER, 71, president, Royer Foundry & Machine Co., Wilkes-Barre, Pa., died March 4 at the General hospital, Wilkes-Barre. Mr. Royer was born in Wilkes-Barre, Feb. 23, 1863, and was educated in the public schools of that city. As a boy he learned the machinist's trade at the Central Railroad of N. J. shops at Ashley, Pa., and for a number of years worked as a machinist for the Lehigh Valley railroad at Sayre and Wilkes-Barre. He then entered the general repair business, establishing a small shop at North Wilkes-Barre with a partner, the firm being known as Royer & Zweibel. While doing a general repair business for many years under that name, Mr. Royer's inventive genius developed the governor for mine hoists, a special packing, and the sand separator and blender for foundries. In 1920 he bought out Mr. Zweibel's interest in the business and in 1921 incorporated it under the name of the Royer Foundry & Machine Co. In 1923 that company moved into a new plant at Kingston, Pa. Although in poor health during the past few years, Mr. Royer continued experimenting and in 1930 developed equipment for removing scrap from sand. He was a member of the American Foundrymen's association, the Foundry Equipment Manufacturers' association, the Society of Engineers of Northeastern Pennsylvania, and several social and fraternal organizations.

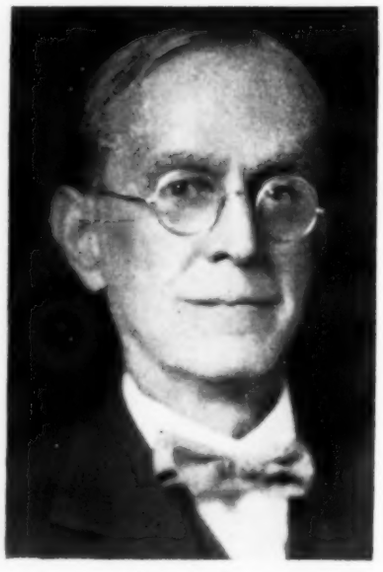
Lahman F. Bower, 75, former vice president, Allis-Chalmers Mfg. Co., Milwaukee, died recently in Shippensburg, Pa.

Frederick A. Geier, 67, president, Cincinnati Milling Machine Co., died at his home March 27. Mr. Geier was one of the founders of the National Machine Tool Builders association and its president in 1910 and 1911. Some years earlier he aided in the organization of the National Metal Trade association.

William J. Stein, a pioneer foundryman and for 18 years an employe of the Ford Motor Co., Detroit, died at his home in Dearborn, Mich., March 6. Mr. Stein was born in Detroit, March 20, 1863. For many years he was employed by the American Car & Foundry Co., and by the Whiting Corp., Harvey, Ill.

Rudolph L. Flintermann, president, Michigan Steel Casting Co., died March 7 at his home in Grosse Pointe Park, Mich. Mr. Flintermann was born in Flint, Mich., April 28, 1871. He was educated in the public schools and graduated from the University of Michigan in 1894. After a year of post graduate work in chemistry, he went to the South Dakota School of Mines as an instructor, and later acted as metallurgist in the gold mines of the Black Hills. Going to Chicago in 1901, Mr. Flintermann became chief metallurgist for the International Harvester Co., the post he held until 1907 when he returned to Detroit. He then organized the Michigan Steel Casting Co.

Alton Farrel, 54, treasurer, Farrel-Birmingham Co. Inc., Ansonia, Conn., died March 28. Mr. Farrel was born in Ansonia, was graduated from St. Paul's school and from Yale university. He had been mayor of Ansonia,



G. F. Royer

a member of the military staff of two governors.

Frank Mixter, 80, chairman of the board, Rock Island Stove Co., Rock Island, Ill., died March 3. Mr. Mixter was born in Rock Island, Nov. 7, 1853. He was educated in the public schools of that city and later completed his studies in the East. In 1880 he assisted in founding the present Rock Island Plow Co.

Joseph H. Kummer, 52, general sales representative, Fort Pitt Malleable Iron Co., with headquarters in Pittsburgh, died suddenly in New York on March 18. Mr. Kummer was born in Detroit, July 2, 1881, and at an early age became associated with the Fort Pitt Malleable Iron Co. He resided in McKees Rocks, Pa., a suburb of Pittsburgh, where he was connected prominently with business, political and social interests of the municipality. During his career he served on the council of the borough from 1920 to 1923 and also was a member of the board of health from 1927 until the time of his death.

Clarence S. Zipf, 42, general superintendent, Ohio Steel Foundry Co., Springfield, O., died March 1. Mr. Zipf was born in St. Marys, W. Va., March 11, 1891. He served his apprenticeship as a molder with the Duquesne Steel Foundry Co., Coraopolis, Pa., and later was appointed foundry foreman. He also was associated with the Reliance Steel Casting Co., Pittsburgh, and the Pittsburgh Steel Foundry Corp., Glassport, Pa., as foundry foreman. In 1923 he accepted a position with the Ohio Steel Foundry Co., Lima, O., and later was made works manager of the Bay City, Mich., plant of that company. After a brief period he was transferred to the Springfield plant of that company as superintendent.

Erwin J. Mohr, vice president, Gunite Foundries Corp., Rockford, Ill., whose death was announced in the March issue of THE FOUNDRY, was born in Milwaukee April 19, 1892. After completing his education in the Milwaukee schools he learned the machinist trade and later became associated with the Cutler Hammer Co., Milwaukee. Mr. Mohr had been associated with the foundry industry for more than a decade, his first connection being with the Kinite Corp., Milwaukee, where he developed a special alloy cast steel. In 1929 he became associated with the Gunite Corp., Rockford, in a sales capacity. With the consolidation of the Gunite Corp. with the parent company, Rockford Northwestern Malleable Corp., early in 1932, he became vice president of the consolidated company, now known as Gunite Foundries Corp. During his association with that organization he assisted in the development of Gunite iron castings. In December, 1933, he was elected president of the Northern Illinois Foundrymen's association.

Stanley G. Flagg Jr., president of Stanley G. Flagg & Co. Inc., Philadelphia, and a past president of the American Foundrymen's association, died in Philadelphia March 14. His death, attributed to heart disease, was believed to have been hastened by the death of his wife, Mrs. Elise Windrim Flagg, just one week previous. Mr. Flagg was born in Philadelphia, Jan. 21, 1860, and was educated in private schools of that city. At the age of 18 he entered the employment of Stanley G. Flagg & Co., where he acquired a thorough knowledge of the trade from his father. Later he was admitted to membership in the firm, where his energy and aggressiveness contributed greatly toward the building up of that company. Upon the death of his father, he became the senior partner, and when the partnership was dissolved and the company incorporated, he became the first president. Mr. Flagg took an active part in the formation of the American Foundrymen's association and was a

(*Concluded on page* 68)

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CUPOLA LINING and PATCHING

*1. It lasts longer!
*2. It can be laid up faster!
*3. It costs less!

Any one of these three is enough to demand attention from the progressive Foundryman.

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rough and sawed shapes for Cupola, Converter, Ladle, Soaking Pit linings etc.

BUCKEYE SILICA FIRESAND
for Air Furnace Bottoms etc.

BUCKEYE SILICA FIRESTONE—SPALLS
Broken Stone for Drop Forge Furnace Bottoms.

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sawed slabs for lining Acid Vats & Pickling Tanks.

WRITE for BULLETIN No. 4

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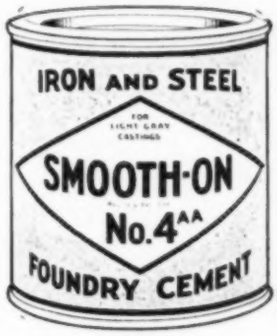
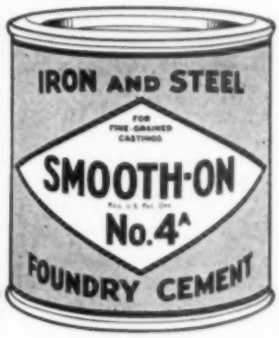


Smooth-On No. 4AA
For light gray castings and machined surfaces. Has high metallic lustre. Takes fine machine finish.

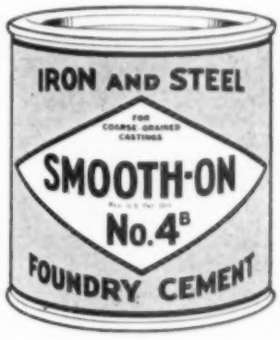


Smooth-On No. 4A
For medium gray castings. A fine grained cement that has a good metallic lustre.

THREE *entirely new* Smooth-On compositions, each with its own distinct color, degree of lustre and fineness of grain, are now available to the foundryman for filling surface blemishes, pits, porous spots, etc., in iron and steel castings of any shade, appearance and quality.

With these three new Smooth-On Cements you can match the shade and lustre of any casting.

This achievement makes the surface corrections undetectable, and adds significant efficiency to Smooth-On treatment.



Smooth-On No. 4B
For dark gray castings. A cement of coarser grain and darker shade.

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Castings judiciously treated with Smooth-On look better and are worth more. *Take advantage of this new Smooth-On development.* Mail the coupon for free hardened and working samples, and give the latter a fair test on your own product.

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4-34

Do it with SMOOTH-ON

(*Concluded from page* 66)
most ardent supporter of that organization. At the Philadelphia convention of the A. F. A. in 1907, Mr. Flagg was elected president and served for one year. He was also a member of the American Society of Mechanical Engineers, the Manufacturers' Standardization society, the American Institute of Mining and Metallurgical Engineers, the American Society for Testing Materials, the Iron and Steel Institute (British) and several local social organizations. He is survived by a son, S. Griswold Flagg 3rd of Radnor, Pa., and a daughter, Mrs. Edward Nugent Head of London.

Dr. Walter Rosenhain, 58, consulting metallurgist, and fellow and past president of the Institute of Metals, London, died at his home at Kingston Hill, Surrey, England, Saturday, March 17. Dr. Rosenhain was educated in Melbourne, Australia, graduating in 1897 from the University of Melbourne in physics and engineering. He then went to England as holder of a research scholarship and spent three years at Cambridge, later taking up the microscopic examination of metals. In 1901 he became scientific adviser to Chance Brothers, Birmingham, glass manufacturers, and in 1908 he was appointed first superintendent of the department of metallurgy and metallurgical chemistry at the National Physical Laboratory, a post which he held for 23 years until his resignation in 1931. In his capacity as metallurgical engineer since that time he has been connected with the British Aluminum Co. Ltd.; Broughton Copper Co. Ltd.; and Messrs. J. Stone & Co. Ltd.

Book Review

Original Design, by Eardley Beswick, cloth, 364 pages, published by Grayson & Grayson, London and supplied by THE FOUNDRY, Cleveland.

Modern industrial life during a period of economic stress, when the tendency toward failure and disintegration constantly increases, is portrayed interestingly in the work of English fiction. The author shows a knowledge of shop practice as well as an insight into the factors which control the lives of the workers of the plant.

Jabez Perriman Sons & Co. Ltd., an old organization of iron founders, machine shop operators, and engineers located in the north, have suffered a severe decline in business with the progression of the economic and industrial depression. This situation has brought about the absolute necessity for economies in every department, and results in a series of salary cuts to permit the company to maintain operations for the small volume of business available, and still manage within the borrowing ability of the leading director, who expects soon to acquire control of the organization. These provide more complicated reactions than anticipated.

Management of the firm is in the hands of a son of the founder, a man who would like to exercise a strong, guiding hand as did his father, but who did not inherit the character and leadership so necessary for the high position. Salary cuts and dismissals, as they are administered, are exceedingly distasteful and the numerous injustices resulting from weak management change the mental fibre of the personnel as the struggle for personal gain in the organization grows.

An order for a machine for molding plastics, the development of an old employe of the plant working on his own after dismissal, brings business again to the company, brings benefits to those who have been unfair, and seemingly forgets the creator of the original design.

Plan Series of Tests Covering Creep of Metals

Joint research committee on effect of temperature on the properties of metals, an organization set up by the American Society for Testing Materials and the American Society of Mechanical Engineers has suggested a correlation program, whereby, as a minimum, one ferritic and one austenitic steel would be subject to creep determination with the temperature and loads collected to approximate industrial use. The test would continue for 3 years and be made under all refinements of the A. S. T. M.-A. S. M. E. tentative code.

Meanwhile, the same materials would be subjected to various accelerated or short-cut methods that have been proposed, and various methods of extrapolation from one to another that have been suggested, would be predicated according to the procedure used by the proponents of each method, and later compared with the actual results of the 3 year test. Material would be held for use in other short-cut methods that may arise later and for possible international comparison of methods with the British committee recently organized.

Obviously, such a program would involve considerable expense, although the committee already has promises of many of its members for co-operation in the program. Designers and users, as well as producers, of alloys for high temperature equipment such as power plant, oil and furnace industry, are invited to inform the secretary of the joint committee, N. L. Mochel, Westinghouse Electric & Mfg. Co., Philadelphia, whether they would like to see such a correlation program taken up by the joint committee.

Obtain Patina With Ammonium Sulphate

A method for the artificial formation of natural patina on copper has been developed by the Copper and Brass Research association, New York. By that method copper roofs and other copper works may be made to turn a beautiful green within a few hours, in contrast with years required for ordinary processes of nature. A chemical solution is sprayed onto the metal and then, with the next fall of rain, the copper becomes green.

In announcing the development, William M. Crane Jr., of the association, stated that the process now is out of the laboratory stage. Chemists of that organization have discovered after some study that natural patina is a basic sulphate. Prior to that time it has been assumed it was a carbonate. This discovery led to the development of a solution consisting mainly of ammonium sulphate. The coating formed by dipping copper into that solution was found to be identical in composition with natural patina. That led to the adaptation of the ammonium sulphate process to application as a spray. The method is inexpensive and simple, although requiring a definite technique.

Five or six spray applications are required, with drying allowed after each. The copper must be clean and must have weathered long enough for a brown tarnish to have developed on the surface. Patina does not appear immediately. If a heavy rain comes along too soon it will probably spoil the work by washing off the salt before it has had an opportunity to act. After spraying there should first be an appreciable period of high humidity or dew or fog, so that the salt can absorb moisture and become active. After six hours or so of at least 80 per cent humidity, the next rain will wash off the excess salt and bring out the blue green color of patina. The color that develops first is somewhat bluer than the natural patina, but on weathering approaches the natural shade.

Makes Cast Steel Drum

A cast-steel brake drum developed especially for use with steel or iron brake shoes is produced by a West Coast manufacturer. It is designed with peripheral fins on the outer surface to increase the area contacted by the air and thereby dissipate rapidly the heat which is developed in metal-to-metal brakes. It is reported to give a smooth braking action, comparable to that of molded brake linings used with cast-iron drums. The material is nickel-chromium-molybdenum steel with a tensile strength of 95,000 to 105,000 pounds per square inch.

DIAMOND SAND BLAST

DIAMOND

LIKE the diamonds from which we take the brand name, Diamond Sand Blast Sand is clean, sharp, fast cutting. Ideal for all manner of sand blasting, being especially prepared for this kind of work.

Call on us to assist you in solving your sand blast problems.

Sand Blast Sand

FOR FAST CLEANING AND FINE FINISH standardize on Diamond Sand Blast Sand. It gives results that are impossible to duplicate with other forms of abrasives, and besides, it is the most economical cleaning agent you can employ.

WASHED, DRIED AND SCREENED SPECIAL SANDS FOR STEEL MOULDING, FURNACE BOTTOMS, CORES, OPENERS,—AND SILICA FLOUR

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GOOSE LAKE

Illinois Clay Products Company

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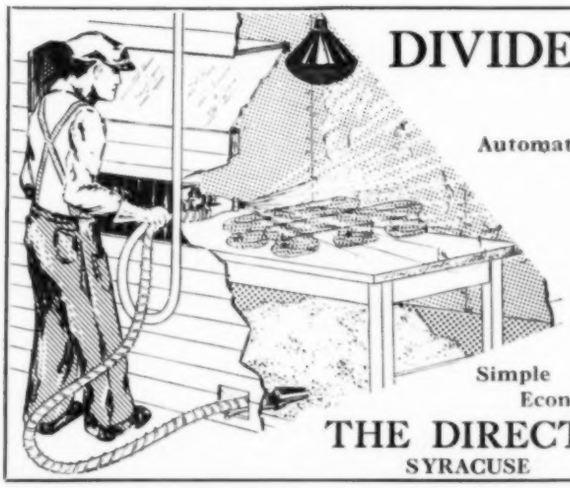
Fire Clay and Fire Clay Flour

Fire Clay Brick

Therm-O-Flake Insulation



DIVIDE AIR SEPARATORS

For removing oil and water from compressed air

Automatically Drained — Very Efficient

* * * *

CYCLONE BLASTERS

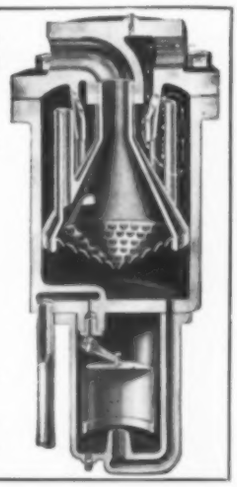
For cleaning Castings and Steel (use Sand, Grit or Shot)

Simple — Efficient — Inexpensive

Economical to operate — Results Guaranteed

THE DIRECT SEPARATOR CO., INC.

SYRACUSE — NEW YORK



New Equipment

For Foundries

Control Pressure Easily on Blow Gun

Cleveland Pneumatic Tool Co., 3734 East Seventy-eighth street, Cleveland, recently has introduced a blow gun designed to withstand hard usage. Two styles are available, one with plain thumb button, and another with an outside lever added to contact the thumb button. The air stream through either type is controlled easily by applying a varying pressure on the control button or lever. The gun is made in two sizes, one having the inlet end pipe tapped ¼ inch and the other ⅜-inch.

Pyrometer Has New Balancing Mechanism

A new type of balancing mechanism is a feature claimed for the new recording potentimeter pyrometer recently introduced by the Foxboro Co., Foxboro, Mass. This balancing device is so designed that it produces a large movement of the pen or print wheel for a small galvanometer deflection, and moves the printing mechanism from one end of the scale to the other quickly, without requiring an extremely fast cycle or rapid motion of the mechanism.

The sensing fingers which detect galvanometer deflection, position the friction roller according to the position of the galvanometer pointer. The V-shaped drive cam then engages and rotates the roller, which in turn transmits its straight-line motion to the slide-wire contact, moving it a corresponding distance. The pen or print wheel, being mounted integrally with the slide-wire contact, moves with it, thus making the record coincide accurately with the measurement.

The recorder is housed in a fume-tight, dust-proof case designed so that it may be either flush or surface mounted. The cast aluminum door with large glass window makes the chart and interior of the instrument readily visible.

Handles Materials With Tractor and Loader

An interesting combination of equipment units is employed by the Caterpillar Tractor Co., Peoria, Ill., in loading and handling refuse and other bulk materials in the foundry. The unit consists of a Caterpillar type tractor made by that company, equipped with a loader made by the Anthony Co., Streator, Ill.

The loader is operated hydraulically through a single control lever in front of the driver's seat. A one-third yard bucket can dig to any depth from 4 inches below the track level to 6 feet above it. The standard boom permits loading into industrial railroad cars or large wagons, and an extra length lift boom can be obtained for such work as loading gondola cars. Views of the unit are shown in the accompanying illustrations.

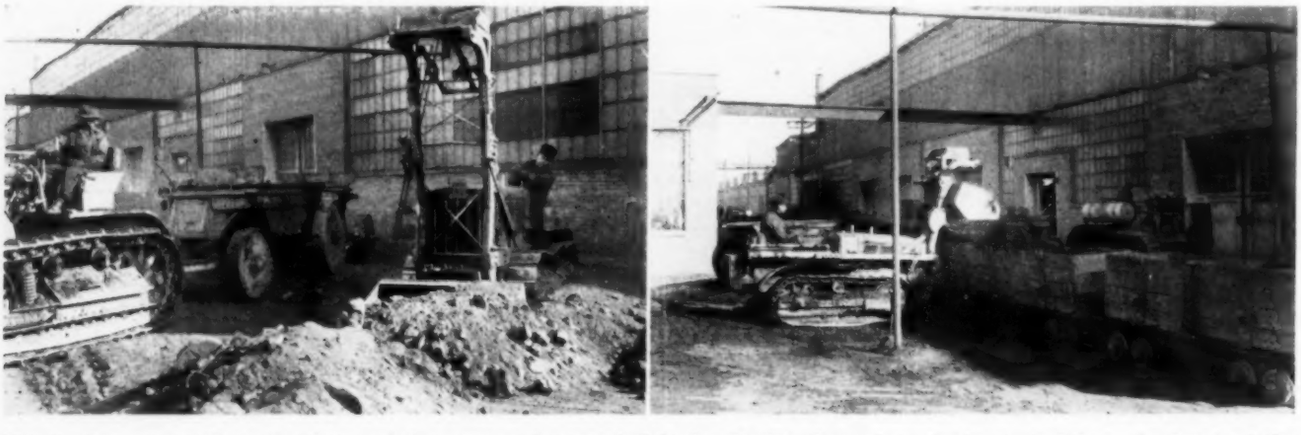
Air Compressor Is of Vertical Type

Gardner-Denver Co., Denver, Colo., has introduced a new line of vertical compressors which it is claimed make possible a saving in floor space. Inlet and discharge valves are cushioned and extra large water jackets completely surround the cylinders and valves. A water cooled intercooler is introduced to conserve power and increase volumetric efficiency by cooling air between stages.

Large diameter crankshafts are supported by three main bearings of the bronze-backed, babbitt-lined, full circle type. Pressure feed lubrication to all bearings is provided through drilled passages, the pressure being provided by a rotary oil pump.

Lightness Features Swing Frame Grinder

Pittsburgh Engineering Works, Pittsburgh, Pa., has introduced a swing frame grinder which it is claimed is of light but sturdy construction. The standard driving motor is full ball bearing, completely enclosed, and fan cooled. The motor is dynamically balanced and has a



The loader, mounted on the front of the tractor, is operated hydraulically through a single control lever in front of the driver's seat

ADVERTISING PAGES REMOVED

solid rotor which adds to rigidity.

The grinder is designed to be hung on any form of crane or trolley support. The hanger is adjustable for balance allowing the desired proportion of weight to hang normally on the wheel. The grinder may be turned 90 degrees on its side when it is required. The wheel spindle has four roller bearings and has a large grease chamber. Wheel centers are arranged with adjustable balancing weights so that the wheel may be rebalanced without removing it from the shaft.

Solid Absorbent Drys Air and Gases

The Pittsburgh Electrodryer Corp., Pittsburgh, in collaboration with the Aluminum Co. of America, Pittsburgh, has introduced a unit for drying air and gases. The unit makes use of a new solid absorbent known as activated alumina, which may be reactivated after it has absorbed moisture to its full capacity.

The new unit is so arranged that it can be connected directly to any air or gas line. When the absorbent has become saturated with moisture, it is cut out of line by the movement of a single lever. The saturated tower then can be reactivated merely by shifting another lever, the material being heated electrically under automatic temperature control. When reactivated, it may, if desired, be cooled rapidly by a water cooling system which is part of the equipment. All valves and electrical connections are so interlocked that no mistake can be made in the cycle of cutting a tower out of service, reactivating, cooling and returning that part of the unit to service.

Fuel Oil Heater Is Built in Sections

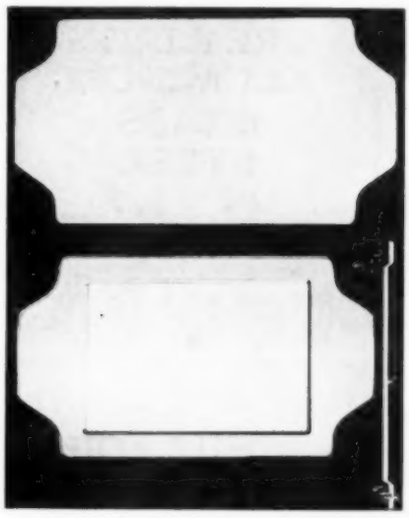
A new type of fuel oil heater designed to provide a flexible and compact installation has been developed by the Griscom-Russell Co., 285 Madison avenue, New York. Each unit of the heater consists of two parallel steel pieces each serving as a shell for a single heating pipe. The return bend is located at one end and all inlet and outlet connections at the other. The heating unit is of special design and has a fin heating surface to permit rapid transfer of heat from the steam contained in the inside of the pipe to the oil flowing along the fined surface inside the shell.

The units, being standard and interchangable, can be arranged in series or parallel as required by the duty. Additional sections can be connected to an existing installation.

Aluminum Plates Are Either Flat or Offset

National Aluminum Co., Racine, Wis., recently has introduced a line of cast aluminum pattern plates of both the flat and offset design. Views of the two styles of plates are shown in the accompanying illustration.

The cast aluminum offset plates are claimed to be straight, level and



Flask pin and vibrator ears are of standard design on both types of plates

extremely accurate and parallel in thickness. The offset is $\frac{3}{8}$-inch with 30 degrees taper and pattern can be mounted safely 1-inch in the flask or $\frac{1}{2}$-inch from the top of the offset.

Both the offset and flat plates have flask pin and vibrator ears 8 x 5 x 2 $\frac{1}{2}$ inches. The plates are made within the limits of 0.004 inches plus or minus. The line covers a wide variety of flask sizes, ranging from 10 x 12 to 19 x 20 inches. The plates have a 1-inch margin on all sides of the flask.

Unit Analyzes Furnace Atmospheres

Bacharach Industrial Instrument Co., 700 Bennett street, Pittsburgh, has developed a combustible gas analyzer for testing the furnace atmosphere. The unit operates on the principle of catalytic combustion. A sample of gas to be analyzed is passed at a constant velocity through a gas cell containing an electrically heated platinum wire. The combustible gases are mixed with a sufficient quantity of air to provide complete combustion, and the electrical resistance of the wire is compared with that of an identical wire mounted in another cell which contains air and is sealed.

The two platinum wires are arranged to form two arms of a Wheatstone bridge, the two other arms of the bridge being fixed resistance coils. Combustion along the wire in the gas cell increases the temperature of the wire and consequently its electrical resistance. Since the wire in the air cell always maintains itself at a constant temperature and resistance, any increase in resistance of the wire in the gas cell throws the bridge out of balance and causes a deflection of the galvanometer. This deflection is proportional to the combustible content of the gas under analysis, and the galvanometer scale is calibrated in per cent of combustible gases.

Develops Heat Resisting Aluminum Paint

Relinus Co., Hempstead, N. Y., recently has developed a heat resisting aluminum paint for refractories which it is claimed will withstand more than 1500 degrees Fahr without fading. This product may be used for large brick surfaces and linings. The company also has completed research work on a refractory paint to withstand 3000 degrees Fahr. The latter is a thin, superrefractory film or lining for fire boxes, boiler furnaces, and other places of like character.

Introduces Relays

A line of instantaneous and time delay plunger-type relays for protection against overcurrent and undervoltage, and for use as auxiliary relays, has been introduced by the General Electric Co., Schenectady, N. Y. The same principle of operation is common to the entire line and depends upon the action of a magnet coil in attracting or releasing a plunger when predetermined values of voltage or current are present in the coil circuit. The relays are all single-pole, and include a variety of adjustments and convertible features.

Checks Dermatitis

Milburn Co., Free Press building, Detroit, has introduced a compound for preventing and checking occupational dermatitis resulting from various cooling lubricants, compounds, chemicals, alkalis, caustics, etc. The material is a protecting and cleansing cream containing, with its other ingredients, sulpho-thysolium.

Rusticide Products Co., 1919 East 19th street, Cleveland, has developed a product for cleaning metal previous to repainting, or for cleaning bright metal on which spots have formed.

PERFECT CORE OIL SATISFACTION
AT MINIMUM COST

NATIONAL SUPPLY CO.
TOLEDO, OHIO

"In the three years we have used your core oil we have found it positively uniform in quality, bakes uniformly and works well in the boxes.

In every detail your oil is entirely satisfactory."

(Signed)
C. F. CARSON,
Fdy. Supt.

For every type of core
AUTOMOTIVE
RADIATORS
MALLEABLE
GREY IRON
ALUMINUM
BRASS
STEEL

Write Mr. Gerrard, Chemist for Free Working Samples

SPROUT WALDRON CO. INC.
MUNCY, PA.

"Our foundry advises that your core oil works smoothly in the boxes, dries quickly and uniformly, but what they appreciate most is the reduction of smoke and gas in both core room and foundry."

(Signed)
J. RUSSELL SMITH
Secretary

CERTIFIED CORE OIL & MFG. CO.

THE HOUSE OF DEPENDABILITY

MANUFACTURING CORE OIL SINCE 1905

CORE OILS — CHILL OIL — PARTING

1104 So. CICERO Ave.
(C. G. W. R. R.)
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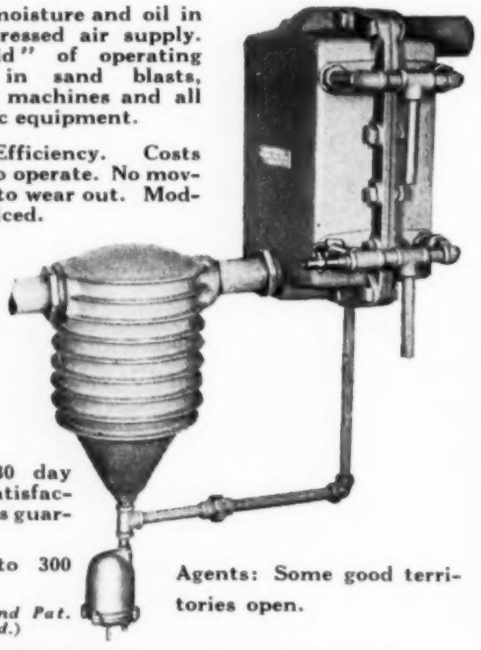
RUEMELIN
COMPRESSED AIR DRYERS

Extracts moisture and oil in the compressed air supply. "Gets rid" of operating troubles in sand blasts, moulding machines and all pneumatic equipment.

Highest Efficiency. Costs nothing to operate. No moving parts to wear out. Moderately priced.



Sent on 30 day trial. Satisfactory results guaranteed.

Sizes up to 300 cubic feet.

(Patented and Pat. Applied.)

Agents: Some good territories open.

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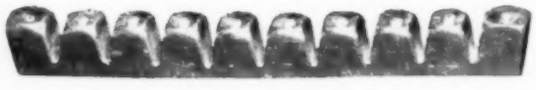
1587 S. First St., Milwaukee, Wis.
(Mfr's Sand Blast and Dust Collectors)

THE
BRITISH ALUMINIUM
CO. LTD.

VIRGIN
ALUMINUM



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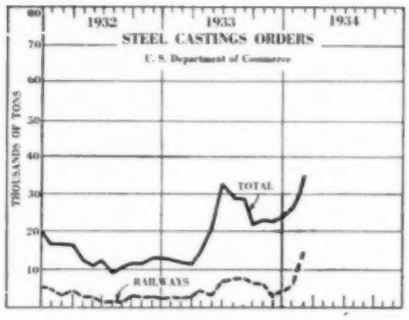

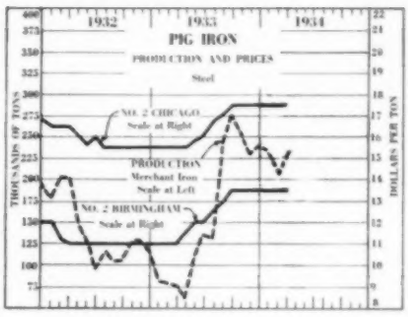

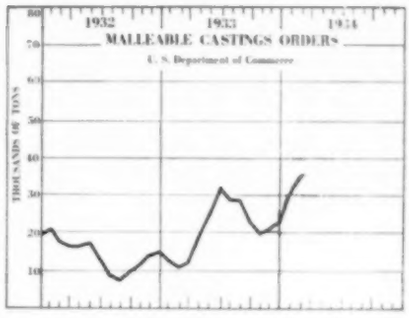

Foundry Activities

Reflect Industrial Trends

PRESSURE CASTINGS INC. recently has been incorporated by William H. Rosenfeld, Nelson F. Jacobs and E. Gordon and has leased the second floor of the Stearns Motor building, 12435 Euclid avenue, Cleveland. The company specializes in high pressure brass, bronze and aluminum die castings. Sales offices are maintained in Chicago, Detroit and New York.

* * *

Hart-Parr division of the Oliver Farm Equipment Co., Charles City, Iowa, reopened March 1.

* * *

Michigan Die Casting Co., Detroit, has been incorporated by Louis W. Blauman, 8550 LaSalle boulevard.

* * *

Holland Furnace Co., Holland, Mich., is operating practically at capacity, according to T. P. Cheff, vice president and production manager.

* * *

Batavia Foundry & Machine Co., Batavia, Ill., suffered slight fire damage recently in its melting department.

* * *

Singer Mfg. Co., 149 Broadway, New York, plans an industrial development on a 289 acre tract at Somerville, N. J.

* * *

J. P. Hansen Foundry Co., 1749 Ballou avenue, Chicago, has been incorporated by J. P. Hansen, P. T. Driscoll and K. K. Wildman.

* * *

American Foundries Inc., Seattle, has opened its new plant at 2944 First avenue, south, for the production of gray iron castings.

* * *

Homestead Valve Mfg. Co., Coraopolis, Pa., has appointed Beckwith Machinery Co., Pittsburgh, as distributor in the Pittsburgh territory.

* * *

Dominion Foundries & Steel Ltd., Hamilton, Ont., will build a one story addition at a cost of $30,000 with equipment.

* * *

Officers of the Flour City Ornamental Iron Co., Minneapolis, recently reported business in 1934 as 100 per cent better than during the early part of 1933.

* * *

Sparta Foundry Co, Sparta, Mich., manufacturer of piston ring castings, reported sales in February as two and one-half times larger than during the corresponding month a year ago.

* * *

Columbian Iron Works, Chestnut street, Chattanooga, Tenn., will build a two-story addition to its plant at a cost of $40,000. R. R. Harris is secretary of the company.

* * *

Headford Bros. & Hutchins Foundry Co., Waterloo, Iowa, recently renewed its articles of incorporation. E. H. Headford is president and W. E. Robinson secretary.

* * *

Orders for steel and malleable castings placed by the Pennsylvania railroad have increased operations of a number of plants in the Pittsburgh district.

* * *

Milwaukee Malleable & Grey Iron Works, Milwaukee, recently started work on an extension to its foundry at 2773 South Twenty-ninth street. Charles A. Gutenkunst is general manager.

* * *

Iowa Foundry Co., West Second and Cook streets, Sioux City, Iowa, has introduced a new tubular automatic gas and oil burning furnace, and other types of heaters.

* * *

Lee Foundry & Machine Co., Mill and Ann Arbor streets, Plymouth, Mich., with exception of pattern and machine shops practically was destroyed by fire March 14 with a loss of $100,000. The plant will be rebuilt.

* * *

R. Perlick Brass Co., 1825 West St. Paul avenue, Milwaukee, has established a brass foundry. The company specializes in brewer's tank fittings and beer dispensing equipment.

* * *

Clinton Pattern & Foundry Corp., Manitowoc, Wis., has been organized to produce aluminum and brass castings, by Carl J. Clinton, Edward J. Hoffman, Dr. George M. Hoffman and Mrs. Lena Clinton.

* * *

Utilities Foundry Corp., Elmira,

RAW MATERIAL PRICES
April 4, 1934

Iron	
No. 2 foundry, Valley	$17.50
No. 2 Southern, Birmingham	13.50
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.50
Basic, Buffalo	16.50
Basic, Valley	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	18.00
Coke	
Connellsville beehive coke premium	$5.00
Wise county beehive coke	3.50 to 4.25
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$14.00 to $14.50
Heavy melting steel, Pitts	14.00 to 14.50
Heavy melting steel, Chicago	11.50 to 12.00
Stove plate, Buffalo	10.75 to 11.25
Stove plate, Chicago	7.25 to 8.25
No. 1 cast, New York	8.50 to 9.00
No. 1 cast, Chicago	9.00 to 10.00
No. 1 cast, Pittsburgh	13.00 to 13.50
No. 1 cast, Philadelphia	12.50 to 13.00
No. 1 cast, Birmingham	9.00 to 9.50
Car wheels, iron, Pittsburgh	13.00 to 13.50
Car wheels, iron, Chicago	12.00 to 12.50
Railroad malleable, Chicago	12.25 to 12.75
Malleable, Buffalo	13.25 to 13.75
Nonferrous Metals	
	Cents per pound
Casting copper, refinery	7.75
Straits tin	55.25
Aluminum, No. 12, producers	18.00 to 22.00
Aluminum, No. 12 remelt Cleveland	15.50 to 16.00
Lead, New York	4.00
Antimony, New York	7.75 to 7.85
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	4.30

GOULAC

Carload Shipments from ERIE, PA.

DRY BINDER

ROBESON PROCESS CO.
AMERICAN GUM PRODUCTS CO.
230 Park Ave. New York

Stocks at

Birmingham, Ala.	Detroit, Mich.	New Haven, Conn
Boston, Mass.	Holyoke, Mass.	Philadelphia, Pa.
Buffalo, N. Y.	Indianapolis, Ind.	Pittsburgh, Pa.
Chicago, Ill.	Milwaukee, Wis.	St. Louis, Mo.
Cincinnati, Ohio	Minneapolis, Minn.	Toronto, Ont.
Cleveland, Ohio	Newark, N. J.	Montreal, Que.

GLUTRIN

Carload Shipments from Ausable Forks, N. Y. and Erie, Pa.

LIQUID BINDER

Auto Malleables
Plumbing Goods
Stove Burners
Manifolds
Pipe Fittings
Vacuum Cleaners
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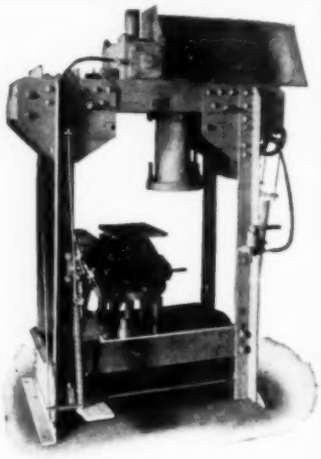
Carburetors
Specialties



Cores for the above castings are being made universally on our machines, resulting in greatly increased production and better cores.

We have a machine for your job.

Your Correspondence Solicited

Wm. Demmler & Bros.
Kewanee, Illinois

When you «Switch to Steel» for cleaning castings make sure of getting best results by using genuine heat-treated American «Eversharp» Steel Grit ● or "Standardized" Steel Shot made by American workmen to definite standards of quality. There *is* a difference. Make your test with the best!

THE AMERICAN STEEL ABRASIVES CO.
Galion, Ohio

N. Y., recently has been organized with a capital of $120,000 by George A. Skelly and Lawrence S. Hess. The company is operating a plant on College avenue.

* * *

Hurley Machine Co., Chicago, has purchased the building and equipment of Meadows Mfg. Co., Bloomington, Ill., manufacturer of electrical and gasoline washing machines.

* * *

Lombard Iron Works & Supply Co., Augusta, Ga., recently started operations after being idle for 4 years. It is expected that 125 persons will be employed before midyear.

* * *

Commonwealth division of the General Steel Castings Corp., Granite City, Ill., resumed operations late in March with an initial force of about 500 men. Employment is expected to reach 1000 by the latter part of April.

* * *

Pontiac Casting Co., Pontiac, Mich., recently was organized by Amos Kelly and associates. The company has leased the former 1-story plant of the Briscoe Device Co. and will produce automotive castings.

* * *

John D. Ward Foundry, Elmira, N. Y., recently severely damaged by fire, resumed operations March 19 in the Newark Creamery building, Wellsburg-Lowman highway, Elmira. The company manufactures brass plumbing supplies.

* * *

A company has been formed by Stewart F. Hancock and John Wilkinson, Hills building, Syracuse, N. Y., to purchase the plant and business of the Ames Iron Works, Oswego, N. Y., and place it in operation.

* * *

Index of orders for foundry equipment, according to the Foundry Equipment Manufacturers association, Cleveland, was 65.8 in February as compared with 37.2 in January and 16.2 in February, 1933. Index of shipments in February was 42.9, and unfilled orders 56.3.

* * *

Auburn Foundry, Inc., Auburn, Ind., which has been incorporated since March, 1932, recently obtained a license in the state of Michigan to operate a sales office in Detroit for handling stokers and boiler plant equipment. The item regarding the recent incorporation of this plant, and presented in the March issue of THE FOUNDRY, was in error.

* * *

Pacific Car & Foundry Co., Seattle, has been reorganized by Paul Pigott and associates, who recently purchased it from the American Car & Foundry Co. Paul Pigott has been elected president, H. N. Curd, vice president and general manager, William Pigott Jr., vice president and treasurer and W. S. Bassage, secretary

* * *

United States Pipe & Foundry Co., Burlington, N. J., has opened a sales office in room 608 Earle building, Washington, in charge of S. E. Linderman. It will also open a sales office April 1 in the Consolidated gas building, Boston, in charge of Carl N. Brown, formerly in the Kansas City, Mo. office. The latter is succeeded by R. C. Lemert from the office at Birmingham, Ala.

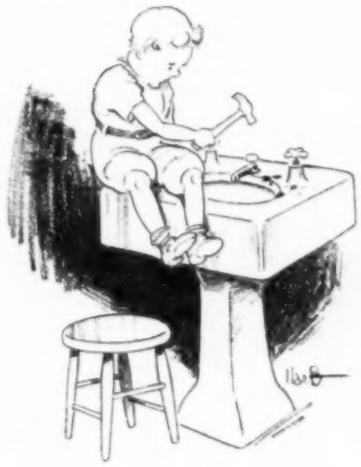
* * *

Production of steel castings in the Philadelphia district increased 10.2 per cent in February over the preceding month, according to reports received by the Industrial Research department of the University of Pennsylvania, Philadelphia. Gray iron castings production declined 7.3 per cent and the output of malleable iron castings was off 14.1 per cent.

* * *

Kanawha Mfg. Co., Charleston, W. Va.; Ashmore, Bensen, Pease & Co. Ltd., Stockton-on-Tees, England; Ealing Foundry Ltd., London England; Cameron & Robertson Ltd., Kirkintilloch, Scotland; Hille Werke, A. G., Soest, A. G. Foundry, Germany; Fonderie Milanese de Acciaio, Milan, Italy and Societe de Produits Metallurgiques, Paris, France, have been licensed to produce Meehanite metal.

Faked Foundry Facts



Chipping Hammer

New Trade Publications

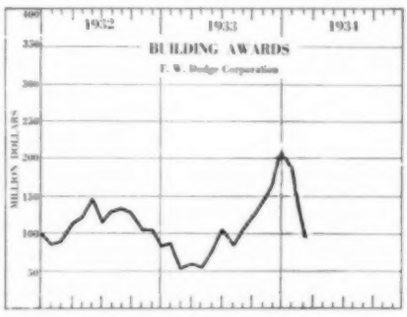
BAKELITE—A wide variety of molded products of bakelite for electrical, mechanical and chemical use are described and illustrated in an interesting booklet of the Bakelite Corp., 247 Park avenue, New York. A brief description of the molding processes and the necessary equipment employed also is included.

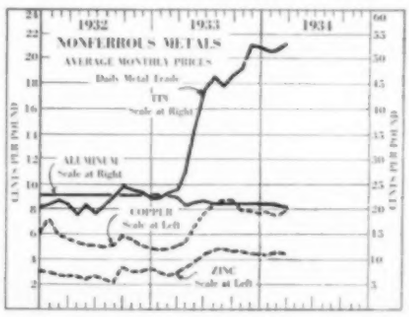
PUMPS—Worthington Pump & Machinery Corp., Harrison, N. J., has published a bulletin on its two-stage volute centrifugal pumps. The publication gives lists of parts for two types of pumps and discusses the specifications for the units.

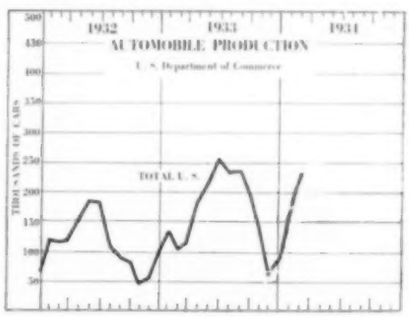
FURNACE INSULATION—Johns-Manville, 22 East 40th street, New York, has published a booklet devoted to the "Insulation of Industrial Furnaces and Ovens." A wide variety of applications are pictured and discussed, and numerous products of the company used for insulating purposes are described and illustrated.

MOTORS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has published a bulletin on its line of explosion-resisting motors in ratings up to 200 horsepower. A special ventilating system is used in the larger sized motors to keep the frame size comparable to that of the standard open motor of the same rating.

INDICATING PYROMETER—Foxboro Co., Foxboro, Mass., has published bulletin 192 illustrating and describing its potentiometer type indicating pyrometer. The temperature scale on the unit is drawn on a dial 6 inches in diameter and provides 17 inches of actual temperature scale, so that it can be read with great precision.







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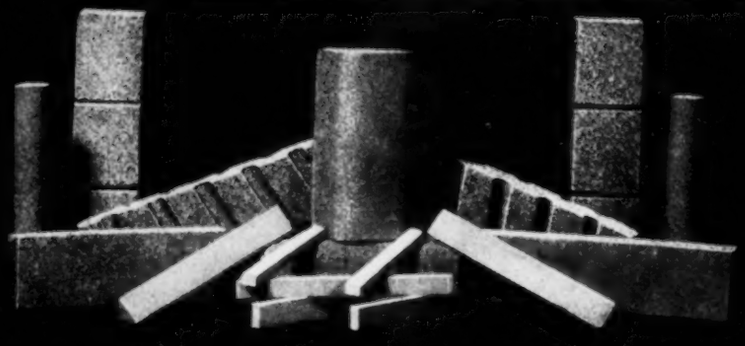

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